IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF VIRGINIA
RICHMOND DIVISION

ORBITAL AUSTRALIA PTY LTD and ORBITAL FLUID TECHNOLOGIES, INC.,	)	Civil Action No. 3:14-cv-808-REP
	)	JURY TRIAL DEMANDED
Plaintiff(s),	)	
	)	
DAIMLER AG, MERCEDES-BENZ USA LLC, MERCEDES-BENZ US INTERNATIONAL INC., ROBERT BOSCH GMBH, and ROBERT BOSCH LLC,	)	
Defendant(s).		

AMENDED COMPLAINT FOR PATENT INFRINGEMENT

This is a civil action for patent infringement by Orbital Australia Pty Ltd ("Orbital Australia") and Orbital Fluid Technologies, Inc. ("Orbital USA") (collectively, "Orbital") against Daimler AG ("Daimler"), and its United States subsidiaries, Mercedes-Benz USA, LLC ("Mercedes USA") and Mercedes-Benz U.S. International, Inc. ("Mercedes International") (collectively, "Mercedes"), and Robert Bosch GmbH ("Bosch Germany") and its United States subsidiary Robert Bosch LLC ("Bosch USA") (collectively, "Bosch"), for infringement of United States Patent Nos. 6,923,387 (the "'387 patent"), 5,655,365 (the "'365 patent"), and 5,606,951 (the "'951 patent") (collectively, the "Asserted Patents"), under 35 U.S.C. § 271. True and correct copies of the Asserted Patents are attached hereto as Exhibits 1 through 3, respectively. Orbital seeks a judgment finding that Mercedes has infringed the Asserted Patents.

Orbital seeks a judgment finding that Bosch has infringed the ’387 patent. Orbital seeks a judgment awarding Orbital compensatory damages and permanent injunctive relief enjoining Mercedes and Bosch from using the patented inventions of the ’387 patent, or a compulsory license fee if the Court determines that injunctive relief is not appropriate. Orbital seeks a judgment awarding compensatory damages for Mercedes’ infringement of the ’365 and ’951 patents. By and through its undersigned counsel, Orbital alleges as follows:

THE PARTIES

1. Plaintiff Orbital USA is a Delaware corporation with current ownership interest in Synerject LLC, a joint venture, located at 201 Enterprise Dr., Newport News, Virginia, 23603. During a period of development of the Asserted Patents, Orbital USA had its principal place of business in Newport News, Virginia. Orbital USA is a wholly owned subsidiary of Orbital Australia. Orbital USA is an exclusive licensee, in the automotive field, of the Asserted Patents.

2. Plaintiff Orbital Australia is an Australian company with its principal place of business at 4 Whipple St., Balcatta, Western Australia, 6021. Orbital Australia is, and at all relevant times has been, the sole owner of each of the Asserted Patents, including the right to collect damages for past infringement of the Asserted Patents.

3. Defendant Daimler is a corporation organized under the laws of Germany with its principal place of business at Mercedesstr. 137, 70327 Stuttgart, Germany.

4. Defendant Mercedes USA is a Delaware limited liability company with its principal place of business at One Mercedes Drive, Montvale, New Jersey, 07645. Mercedes USA is a subsidiary of Daimler that is responsible for the distribution and marketing of Mercedes-Benz vehicles in the United States.

5. Defendant Mercedes International is an Alabama corporation with its principal place of business at One Mercedes Drive, Vance, Alabama, 35490. Mercedes International is a

subsidiary of Daimler responsible for the manufacture of Mercedes-Benz vehicles in the United States.

6. Upon information and belief, and as more specifically alleged below, Daimler, Mercedes USA, and Mercedes International together, individually, and/or through agents, infringe each of the Asserted Patents.

7. Defendant Bosch Germany is a limited liability company organized under the laws of Germany with its principal place of business at Robert-Bosch-Platz 1, 70839 Gerlingen, Germany.

8. Defendant Bosch USA is a Delaware limited liability company with its principal place of business at 3800 Hills Tech Drive, Farmington Hills, Michigan, 48331. Bosch USA is a wholly owned subsidiary of Bosch Germany.

9. Upon information and belief, and as more specifically alleged below, Bosch Germany, and Bosch USA together, individually, and/or through agents, infringe the ’387 patent.

JURISDICTION AND VENUE

10. This Court has jurisdiction over the subject matter of this action pursuant to 28 U.S.C. §§ 1331 and 1338(a) because this action arises under the patent laws of the United States.

11. The Court has personal jurisdiction over each Mercedes defendant under Virginia Code § 8.01-328.1 because each has sufficient minimum contacts with the forum, resulting from its regular transaction of business within the Commonwealth of Virginia and within the Eastern District of Virginia. Each Mercedes defendant directly or indirectly sells vehicles through twelve dealerships in Virginia, nine of which are located within the Eastern District of Virginia. Mercedes’, including Daimler’s, Mercedes USA’s, and Mercedes International’s, efforts in advertising online and through these established locations demonstrate that it has established the requisite minimum contacts in Virginia. Additionally, through these dealerships and advertising

activities, each of the Mercedes defendants has established direct contacts with Virginia residents. Daimler leads customers to these Mercedes dealerships through its website, by directing United States customers to the Mercedes USA website, which provides specific information regarding Mercedes dealerships across the United States, including Virginia. Further, Daimler and Mercedes International manufacture vehicles to be transferred into, and sold within, the Commonwealth of Virginia. The Mercedes dealerships within the Eastern District of Virginia sell Mercedes vehicles manufactured by Daimler, manufactured by Mercedes International, and brought into the district by Mercedes USA and/or a concerted effort between Daimler, Mercedes USA, Mercedes International and their agents. The Mercedes defendants, directly or through their agents, operate the accused Mercedes vehicles in an infringing manner during transportation and/or sale into and in the Eastern District of Virginia and the Newport News Division. Further, following the sale of the Mercedes vehicles, Mercedes' customers routinely use the vehicles in an infringing manner in the Eastern District of Virginia and in the Newport News Division.

12. The Court has personal jurisdiction over each Bosch defendant under Virginia Code § 8.01-328.1 because each has sufficient minimum contacts with the forum, resulting from its regular transaction of business within the Commonwealth of Virginia and within the Eastern District of Virginia and the Newport News Division. Bosch defendants manufacture a wide variety of automotive parts which can be used on a variety of vehicle makes and models. Each Bosch defendant has established direct contacts with Virginia residents through advertising and sale of its automotive parts online, through dealerships, and through third party retailers. Bosch USA's website identifies over 50 different vehicle makes, including Mercedes, for which Bosch

manufactures parts.[1] These parts are delivered to and used by vehicle dealerships, including Mercedes dealerships. Additionally, the Bosch USA website provides the location of third party retailers which stock and sell Bosch automotive parts.[2] More specifically, when searching for gasoline direct injection parts, the Bosch USA website identifies 17 third party retailers that stock, for sale, Bosch automotive parts, within 20 miles of the Spottswood W. Robinson III and Robert R. Merhige, Jr., Federal Courthouse and eight third party retailers within 20 miles of the Newport News Federal Courthouse. Bosch Germany's and Bosch USA's efforts in advertising online and selling Bosch auto parts through these established locations demonstrate that each Bosch defendant has established the requisite minimum contacts in Virginia. Further, upon information and belief Bosch USA and/or Bosch Germany, directly or through agents, are responsible for the importation of Bosch automotive parts, and the delivery and sale of the automotive parts to dealerships and third party retailers in the Eastern District of Virginia and the Newport News Division.

13. Venue is proper in this District, including in the Newport News Division and this Division under 28 U.S.C. §§ 1391 and 1400(b) and Local Civil Rule 3(C) because, as alleged above, each defendant is a corporate entity subject to personal jurisdiction in this District, including in the Newport News and this Division. Further, because each Defendant has distributed, advertised, sold and/or used, and/or has induced others to use, methods and systems that infringe one or more of the Asserted Patents, a substantial part of the events giving rise to the claims asserted herein occurred, and are continuing to occur, in this District, including in the Newport News and this Division. Additionally, part of the work that led to the patented inventions occurred in this judicial district and the Newport News division.

[1] http://www.boschautoparts.com/
[2] http://www.boschautoparts.com/gasoline-direct-injection

BACKGROUND

14. Orbital is a specialized engine and vehicle systems innovation company with 30 years of experience in advanced technology and product development. Such technology and product developments have been embedded in a wide array of engine and vehicle products around the world. Orbital is focused on finding high efficiency, low emission, world class solutions for customers in the following industries: automotive, powered recreation, industrial, resources, government, aerospace, and in other segments. As part of this focus, Orbital initiated and directed multiple projects upon which the original designers of the claimed inventions of the ’387, ’365, and ’951 patents worked, leading to these claimed inventions.

15. Orbital began developing and using centrally-mounted, spray-guided direct fuel injection systems in the early 1980’s. Orbital used direct injectors in 2 stroke engines and was seen as a world leader in making internal combustion engines cleaner and more fuel efficient. In 1995, Mercedes expressed interest in Orbital’s technology and began evaluating the Orbital Combustion Process (OCP) on a 4 stroke Mercedes engine. Thereafter, Orbital and Mercedes established a working relationship focused on applying the OCP technology to a dedicated 4 stroke engine system to improve fuel efficiency and emissions.

16. By 1995, Orbital Australia filed the ’365 patent (“Method of Operating an Internal Combustion Engine”) and ’951 patent (“Engine Air Supply Systems”).

17. In 1997, Orbital and Siemens Automotive Corporation (later Continental Automotive Corporation) formed the Synerject LLC joint venture to provide original equipment manufacturers (OEMs) in the marine, motorcycle and recreation industries with gasoline Engine Management Systems (EMS) and fuel system components.

18. In the 1997/98 timeframe, Orbital Australia incorporated the OCP into a Mercedes engine and tested its performance. One of the main technical issues with direct

injection systems is the effect of carbon deposits that build up on the injector as a result of fuel combustion. The carbon deposits negatively affect the spray pattern of the spray guided direct injectors.

19. From 1999-2002, Orbital Australia worked on improvements for deposit control in fuel injector nozzles. Part of this work occurred in the Synerject facility at Newport News, Virginia. This work became the subject of the ’387 patent (“Deposit Control In Fuel Injector Nozzles”), filed in 2000. Synerject’s global headquarters is currently located in Newport News, Virginia. Synerject’s Newport News facility is a 60,000 ft^2 production and design center that manufactures fuel systems, modules, and components.

20. Orbital Australia presented the patented technology for deposit control in fuel injector nozzles to Mercedes in great technical detail after the filing of the ’387 patent.

21. In 2001, Orbital Australia presented at least part of the control strategy claimed in the ’365 patent to Daimler representatives during a visit to Orbital Australia.

22. In 2002, Orbital Australia delivered a demonstrator vehicle to Daimler. This vehicle included the patented injector features. Shortly thereafter, Daimler advised Orbital Australia that they would not be proceeding with the Orbital project.

23. Mercedes has since released numerous versions of vehicles in the United States that include engines with a centrally-mounted, spray-guided direct injection system using Bosch injectors that infringe the claimed features of the ’387 patent. Mercedes has also sold vehicles in the United States that infringe the patented methods and systems of the ’365 and ’951 patents.

24. Daimler manufactures automobiles in Germany that are imported into the United States and are used and sold throughout the United States. Daimler manufactures engines in

Germany that are imported into the United States and used in the assembly of automobiles, which are used and sold throughout the United States.

25. Mercedes USA states on its website that it is a nationwide organization employing over 1,600 people, and has 362 associated dealerships that employ over 22,000 people.[3] Additionally, on its website, Mercedes USA advertises that its employees are working in "core areas" including, but not limited to: (1) Vehicle Preparation Centers; (2) Import & Domestic; (3) Transportation Logistics; (4) Retail Distribution; (5) Vehicle Preparation Center; (5) Vehicle Test Centers, (6) Emissions Control, (7) Service Engineering, (8) Test Centers; and (9) Quality Engineering Center.[4]

26. Mercedes International manufactures vehicles in Vance, Alabama. Mercedes International does not manufacture the engines or transmissions. The engines and transmissions, used in the vehicles manufactured by Mercedes International, are made in Germany and are imported into the United States for assembly at the Mercedes International factory in Vance, Alabama. Additional engines are manufactured in Decherd, Tennessee, by a Daimler joint venture, for assembly at the Mercedes International factory in Vance, Alabama.[5] According to a press release on Daimler's website, Mercedes International manufactured more than 185,000 vehicles in 2013, and has manufactured more than two million vehicles as of September 2014.[6] In 2014, Mercedes International began manufacturing Mercedes-Benz C-Class sedans.[7] Daimler's Dr. Dieter Zetsche, Chairman of the Board of Management of Daimler AG and Head of Mercedes-Benz Cars, stated in a press release, "[w]e are consistently seeing record sales in the

[3] http://www.mbusa.com/mercedes/about_us/companyinfo
[4] http://www.mbusa.com/mercedes/about_us/careers
[5] http://www.ft.com/intl/cms/s/0/4ab9a014-3a0c-11e1-8707-00144feabdc0.html#axzz3QQfbYPcQ
[6] http://media.daimler.com/dcmedia/0-921-656511-1-1735644-1-0-0-0-0-1-0-0-0-1-0-0-0-0-0.html?TS=1422220472667
[7] *Id.*

USA. By launching the new C-Class we are setting new standards in our biggest sales market."[8] Additionally, in the press release, referring to the production at Mercedes International, Daimler's Markus Schäfer, Member of the Divisional Board of Mercedes-Benz Cars, Production & Supply Chain Management, stated, "[t]he local production will enable us to supply the US market more quickly and flexibly. We will lower logistics costs and safeguard ourselves better against exchange rate fluctuations through 'natural hedging.'"[9]

27. On its website, Bosch Germany advertises that it is part of the Bosch Group, which consists of Bosch Germany "and its more than 360 subsidiaries and regional companies in some 50 countries."[10] With regard to the Bosch Group, Bosch Germany's website advertises that its "worldwide development, manufacturing, and sales network is the foundation for further growth."[11] Bosch Gasoline Systems is a division of Bosch Germany, as advertised on Bosch Germany's website, that has areas of operation including, "engine management" and "modules and engine components."[12] Additionally, on its website, Bosch Germany advertises the "High-pressure piezo injector," a fuel injector for gasoline direct injection, and advertises that Bosch Germany should be contacted regarding the injector.[13] Further, the Bosch Germany website provides a product data sheet for the High-pressure piezo injector.[14]

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[8] *Id.*
[9] *Id.*
[10] http://annual-report.bosch.com/annual-report-2013/the-bosch-group/
[11] *Id.*
[12] http://www.bosch.de/en/de/our_company_1/business_sectors_and_divisions_1/gasoline_systems_1/gasoline-systems.html
[13] http://www.bosch-mobility-solutions.com/en/de/_technik/component/PT_PC_BDI_Fuel-Injection-NEU_PT_PC_Direct-Gasoline-Injection_02_10181.html?compId=8000; http://www.bosch-mobility-solutions.com/en/de/about_us/contact/kontaktformular.php
[14] http://www.bosch-mobility-solutions.com/media/en/ubk_europe/db_application/downloads/pdf/antrieb/de_5/gs_datenblatt_piezo_hochdruck_einspritzventil_hdev4_de.pdf

28. Bosch USA advertises that it is a member of the Bosch Group.[15] Bosch USA also advertises that it has a "Gasoline Systems" division that has areas of operation including, "engine management" and "modules and engine components."[16] Gasoline systems is one division of the Automotive Technology sector. On its website, a Bosch USA publication states that "Automotive Technology is the largest business sector for Bosch globally and in North America."[17] The publication identifies that the Automotive Technology sector generated 70 percent of Bosch sales in North America.[18] The publication further states, that the main areas of operation include, *inter alia*, fuel-injection systems for internal combustion engines, and a range of after-sales, engineering-support and service concepts for the automotive aftermarket.[19]

29. Orbital offered Bosch a license for use of several of its injector patents in 2011, including the '387 patent, which Bosch declined.

INFRINGING PRODUCTS LIST

Products Infringing U.S. Patent 6,923,387

30. The Bosch fuel injector, identified as Mercedes part number A2780700687, and Bosch part number 0261500065 ("the Injector"), infringes one or more claims of the '387 patent, as more specifically alleged below. The Injector, according to Bosch, is for use in spray guided combustion processes. Thus, any additional spray guided direct injectors that are substantially similar to the Injector will also infringe one or more claims of the '387 patent. For example, an earlier generation of the Injector, Mercedes part number A2720720187, is believed to be substantially similar to the Injector.

[15] http://www.bosch.us/en/us/our_company_1/our-company-lp.html

[16] http://www.bosch.us/en/us/our_company_1/business_sectors_and_divisions_1/gasoline_systems_1/gasoline-systems.html

[17] http://www.bosch.us/media/us/publication/Bosch_BiNA2014.pdf

[18] Id.

[19] *Id.*

31. The Mercedes vehicles identified in Exhibit 4, incorporate the Injector and infringe one or more claims of the ’387 patent, as more specifically alleged below. Specific vehicles incorporating the Injector can be determined by knowing the Mercedes part number and searching the Mercedes Electronic Parts Catalogue (EPC).

32. Mercedes engines that incorporate the Injector, also infringe one or more claims of the ’387 patent. Specific engines incorporating the Injector can be determined by knowing the Mercedes part number and searching the Mercedes Electronic Parts Catalogue (EPC).

33. To the extent discovery reveals additional Mercedes vehicles and/or engines that include the Injector, or reveals any substantially similar infringing injectors, Mercedes vehicles, and/or Mercedes engines containing the same, Orbital reserves the right to update its list of infringing products.

Products Infringing U.S. Patents 5,655,365 and 5,606,951

34. Mercedes vehicles that include internal combustion engine control systems identified and described in the counts below, infringe one or more claims of the ’365 and ’951 patents, as more specifically alleged below.

35. Due to emissions and regulatory constraints as well as the need for a consistent customer experience, on information and belief, all modern Mercedes vehicle internal combustion engine control systems are believed to be the same as, or for all purposes relevant to these allegations, substantially similar to the internal combustion engine control systems contained in the Mercedes vehicles analyzed in more detail below.

36. Testing conducted on two different Mercedes vehicles revealed that both vehicles infringe, at least, the ’365 patent. Further, third-party diagnostic tool manufacturers state that Mercedes vehicles use the Bosch Motronic control system. Bosch documents show that Mercedes vehicles utilizing Bosch control systems infringe at least one claim of the ’951 patent.

37. Discovery of Mercedes' documents and internal databases will allow for identification of the Electronic Control Units (ECUs) and their applied control systems in Mercedes vehicles, information that is not readily available through public sources. To the extent discovery reveals additional Mercedes vehicles that include internal combustion engine control systems that infringe the '365 patent and/or the '951 patent, Orbital reserves the right to update its list of infringing products.

COUNT I

Patent Infringement of U.S. Patent 6,923,387

38. Orbital re-alleges and incorporates by reference the allegations of paragraphs 1-38 as if fully set forth herein.

39. On August 2, 2005, U.S. Patent No. 6,923,387 (the '387 patent), entitled "Deposit Control in Fuel Injector Nozzles" was duly and legally issued by the United States Patent and Trademark Office. The '387 patent is valid and enforceable.

40. Orbital Australia owns, and at all relevant times has been the sole owner of the '387 patent. Pursuant to 35 U.S.C. § 154(a)(1), Orbital USA, as an exclusive licensee in the automotive field, has the right to exclude others from making, using, offering for sale, or selling the invention disclosed in the '387 patent, including the right to bring this action for damages and injunctive relief.

1. Mercedes

41. In violation of 35 U.S.C. § 271, as more specifically alleged below, each of the Mercedes Defendants, including its affiliates, has directly infringed and continues to directly infringe, literally or under the doctrine of equivalents, one or more claims of the '387 patent, by, without limitation, making, using, importing, selling, and/or offering for sale automobiles in the Eastern District of Virginia and elsewhere within the United States, that incorporate fuel

injectors with deposit control technology that satisfy all of the limitations of one or more of the claims of the ’387 patent.

42. Mercedes has had knowledge of the ’387 patent since, at least, the filing of the Complaint in this action. Additionally, Daimler obtained knowledge of the technology claimed in the ’387 patent during its prior extensive business relationship with Orbital, including through Orbital presentations to Mercedes which included the patented technology.

43. In violation of 35 U.S.C. § 271, the Mercedes Defendants actively induce third-party manufacturers, distributors, importers and/or consumers that purchase or sell Mercedes automobiles incorporating fuel injectors with deposit control technology that satisfy all of the limitations of one or more of the claims of the ’387 patent, to directly infringe one or more claims of the ’387 patent. Daimler induces infringement, at least, by knowingly manufacturing and selling automobiles with the intent that its customers directly infringe the ’387 patent through sales and use of the automobiles in the United States. Mercedes USA induces infringement, at least, by knowingly selling automobiles with the intent that its customers directly infringe the ’387 patent through sales and use of the automobiles in the United States. Mercedes International induces infringement, at least, by knowingly manufacturing and selling automobiles with the intent that its customers directly infringe the ’387 patent through sales and use of the automobiles in the United States.

44. Mercedes’ acts of infringement have caused damage to Orbital, and Orbital is entitled to recover damages in an amount subject to proof at trial.

45. Orbital has been, and continues to be, damaged and irreparably harmed by Mercedes’ infringement, which will continue unless Mercedes is enjoined by this Court.

2. Bosch

46. As more specifically alleged below, in violation of 35 U.S.C. § 271, Defendants Bosch, have directly infringed and continue to directly infringe, both literally and under the doctrine of equivalents, one or more claims of the ’387 patent, by, without limitation, using, importing, selling, and/or offering for sale, fuel injectors with deposit control technology that satisfy all of the limitations of one or more of the claims of the ’387 patent, within the Eastern District of Virginia and elsewhere within the United States.

47. Bosch has had knowledge of the ’387 patent since, at least, the filing of the Complaint. Additionally, Bosch Germany obtained knowledge of the ’387 patent and its existence in 2011, through a licensing offer made by Orbital Australia to Bosch Germany, for the use of the patented technology, including specifically the ’387 patent.

48. In violation of 35 U.S.C. § 271, Defendants Bosch actively induce third-party manufacturers, distributors, importers and/or consumers that purchase or sell Bosch fuel injectors with deposit control technology, that satisfy all of the limitations of one or more of the claims of the ’387 patent, to directly infringe one or more claims of the ’387 patent. Bosch Germany induces infringement, at least, by knowingly manufacturing and selling the Injector with the intent that its customers directly infringe the ’387 patent through sales and use of the Injector in the United States. Bosch USA induces infringement, at least, by knowingly selling the Injector with the intent that its customers directly infringe the ’387 patent through sales and use of the Injector in the United States.

49. Bosch’s acts of infringement have caused damage to Orbital, and Orbital is entitled to recover damages in an amount subject to proof at trial.

50. Orbital has been, and continues to be, damaged and irreparably harmed by Bosch’s infringement, which will continue unless Bosch is enjoined by this Court.

3. Direct Infringement of the ’387 Patent

51. Orbital’s current infringement positions are based upon reasonable information and belief. Orbital anticipates collecting additional evidentiary support through the discovery process. As such, Orbital reserves the right to assert any claims of the ’387 patent, against any additional infringing product identified during the discovery process.

52. Certain Mercedes automobiles incorporate fuel injectors with deposit control technology that literally infringe at least claims 1, 2, 4-6, 10, 14-16, 18, and 19 of the ’387 patent. Specifically, at least the Mercedes automobiles identified in Exhibit 4 were identified by the Mercedes electronic parts catalog (EPC) as containing the Injector.

53. The Injector, manufactured by Bosch, is a fuel injector with deposit control technology, for use in internal combustion engines, that literally infringes at least claims 1, 2, 4-6, 10, 14-16, 18, and 19 of the ’387 patent.

54. While it is Orbital’s position that each defendant literally infringes the asserted claims of the ’387 patent, in the event defendants allege and/or the Court construes a claim term such that one or more of the defendants may be found not to literally infringe one or more of the asserted claims of the ’387 patent, Orbital reserves the right to provide additional contentions, regarding infringement under the doctrine of equivalents.

55. The Injector is used to deliver fuel into engine cylinders, as part of normal engine operation. The Injector is a physical, mechanical part, within the engine. Certain information regarding the Injector and its use can be gained from publicly available information and physical inspection of the Injector. Orbital anticipates obtaining additional information regarding the characteristics of the Injector and its use through discovery.

56. Based upon currently available information, the making, using, selling, offering for sale, and importing of, Mercedes automobiles that include the Injector, Mercedes engines that

include the Injector, and the Injector directly infringe at least claims 1, 2, 4-6, 10, 14-16, 18, and 19 of the ’387 patent, as follows:

a. Claim 1

i. Claim 1 recites, “An injector nozzle for a fuel injected internal combustion engine,”

57. As shown in the images below, the Injector, manufactured by Bosch, found in Mercedes-Benz vehicles is an injector nozzle for a fuel injected internal combustion engine.

High-pressure piezo injector
Gasoline Direct Injection - Fuel injection

Function | Customer benefits

Function of the high-pressure piezo injector

The high-pressure injector is responsible for metering and atomizing the fuel from the fuel rail so that fuel and air are specifically mixed in a certain region of the combustion chamber in order to obtain the best possible combustion of the mixture. To this end, the fuel is concentrated (stratified) in a defined area around the spark plug, depending on the required operating status.

Technical characteristics:

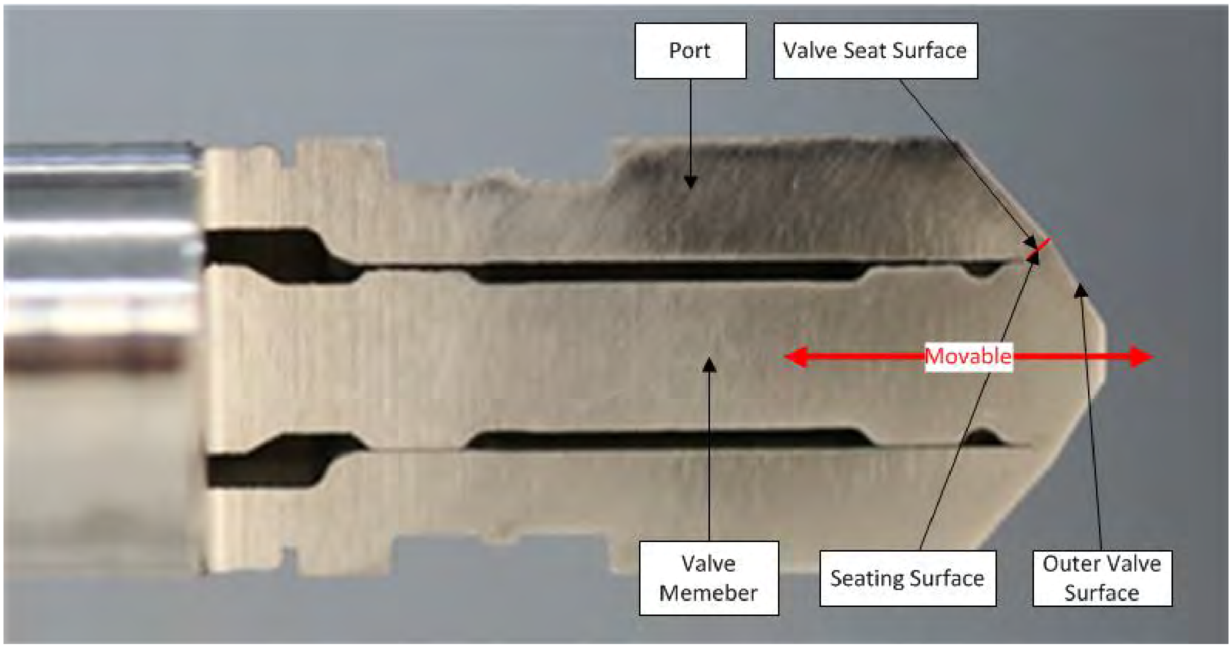
- Outwardly opening piezo fuel injector with directly operated needle
- Spray angle 85° ± 5°
- Large metering range: 0.5 up to 150 mg/stroke at 200 bar (20 MPa)
- System pressure: 200 bar (20 MPa)

Bosch gasoline high pressure piezo injector webpage - http://www.bosch-mobility-solutions.com/en/de/_technik/component/PT_PC_BDI_Fuel-Injection-NEU_PT_PC_Direct-Gasoline-Injection_10181.html?compId=8128#; See also Exhibit 4.

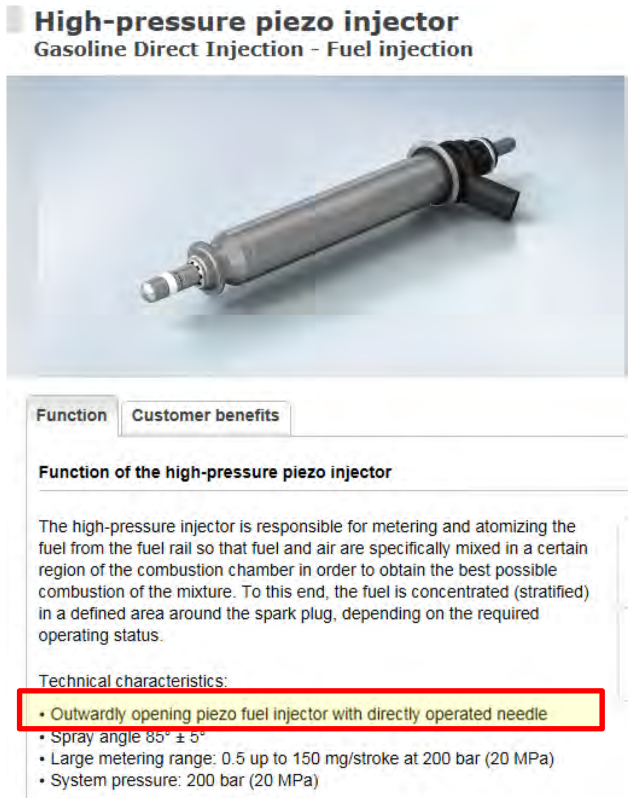
ii. Claim 1 further recites, "said injector nozzle including a port having a valve seat surface and valve member having a seating surface, said valve member being movable relative to the port to respectively provide a nozzle passage between the valve seat surface and the seating surface for the delivery of fuel there-through or sealed contact there-between to prevent said delivery of fuel, the valve member including an outer valve surface located adjacent the seating surface and external to the port,"

58. The Injector includes a port having a valve seat surface and valve member having a seating surface, said valve member being movable relative to the port to respectively provide a nozzle passage between the valve seat surface and the seating surface for the delivery of fuel there-through or sealed contact there-between to prevent said delivery of fuel, the valve member including an outer valve surface located adjacent the seating surface and external to the port.

59. The surfaces of the Injector and nozzle passages can be seen in the photo of the Injector, below, where the injector tip has been cut away to reveal a cross section of the injector nozzle.



60. Further, as shown below, Bosch describes the ability of the Injector to open outwardly for the delivery of fuel.



High-pressure piezo injector
Gasoline Direct Injection - Fuel injection

Function | Customer benefits

Function of the high-pressure piezo injector

The high-pressure injector is responsible for metering and atomizing the fuel from the fuel rail so that fuel and air are specifically mixed in a certain region of the combustion chamber in order to obtain the best possible combustion of the mixture. To this end, the fuel is concentrated (stratified) in a defined area around the spark plug, depending on the required operating status.

Technical characteristics:

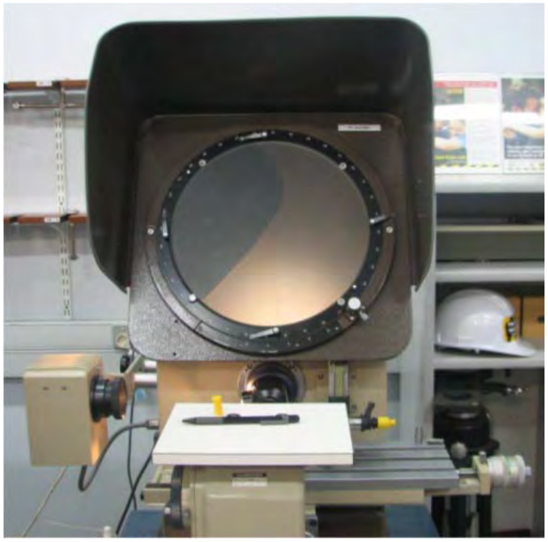
- Outwardly opening piezo fuel injector with directly operated needle
- Spray angle 85° ± 5°
- Large metering range: 0.5 up to 150 mg/stroke at 200 bar (20 MPa)
- System pressure: 200 bar (20 MPa)

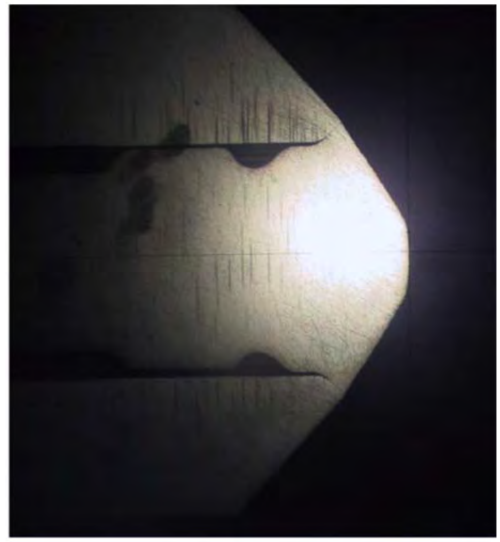
http://www.bosch-mobility-solutions.com/en/de/_technik/component/PT_PC_BDI_Fuel-Injection-NEU_PT_PC_Direct-Gasoline-Injection_10181.html?compId=8128#.

iii. Claim 1 further recites, “wherein a sharp edge is provided on the valve member at the transition between the seating surface and the outer valve surface thereof, for controlling the formation of deposits at or adjacent an exit of the nozzle passage.”

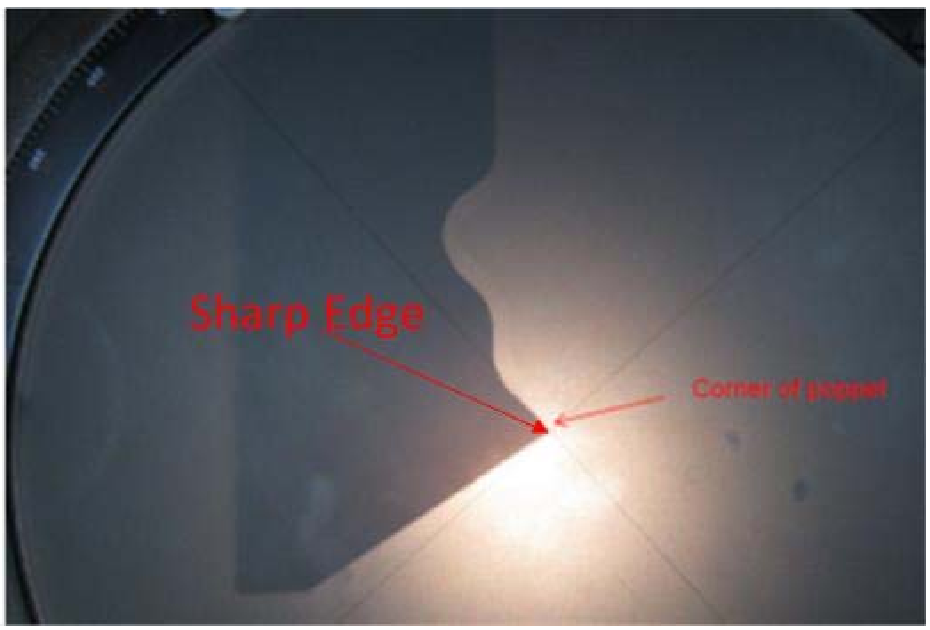
61. The Injector includes a sharp edge provided on the valve member at the transition between the seating surface and the outer valve surface.

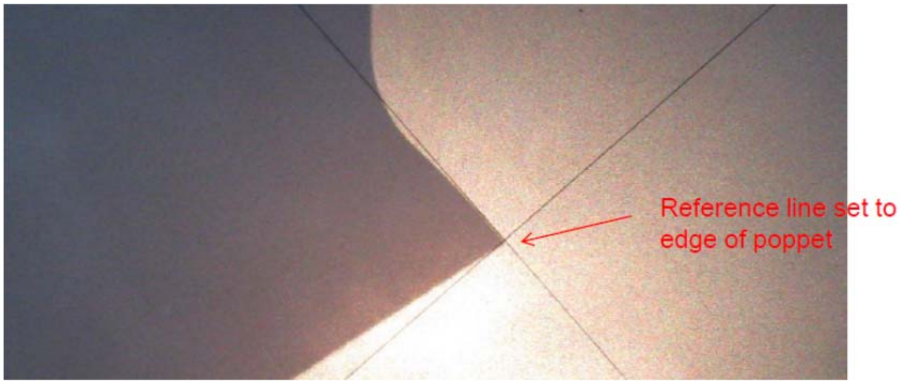
62. For example, the cut away of the Injector can be inspected on an optical shadowgraph device, as shown below.

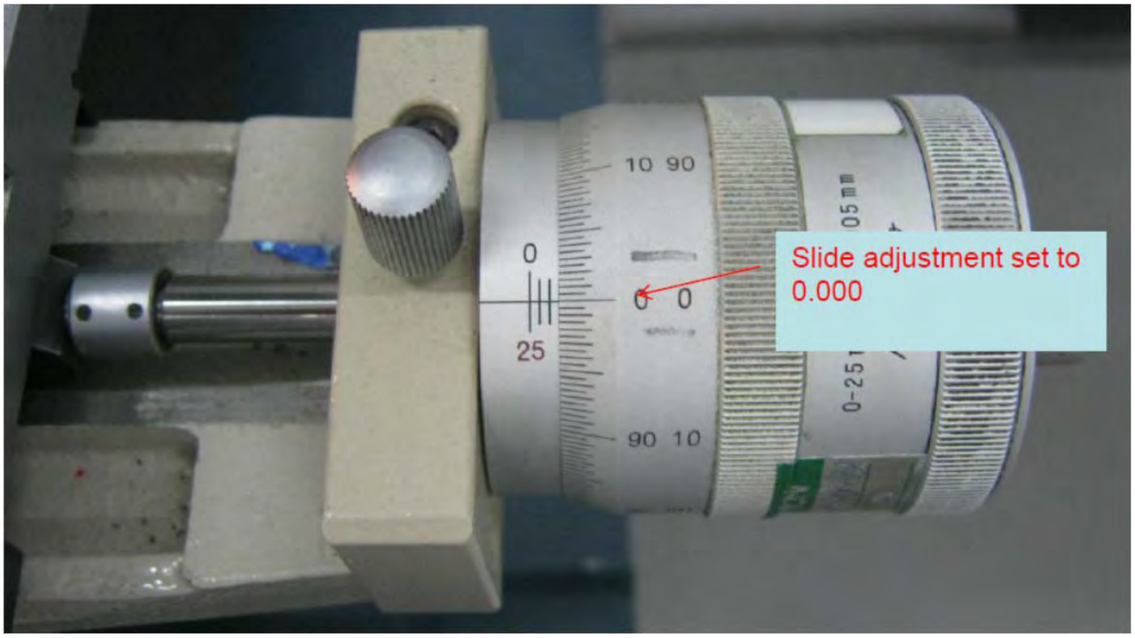




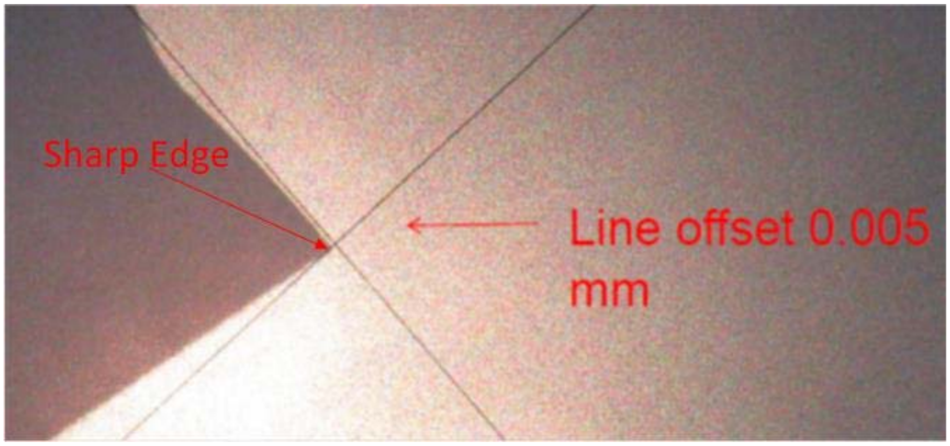
63. The center, outwardly opening poppet of the Injector can be removed in order to inspect the poppet corners on an optical shadowgraph device, as shown below.



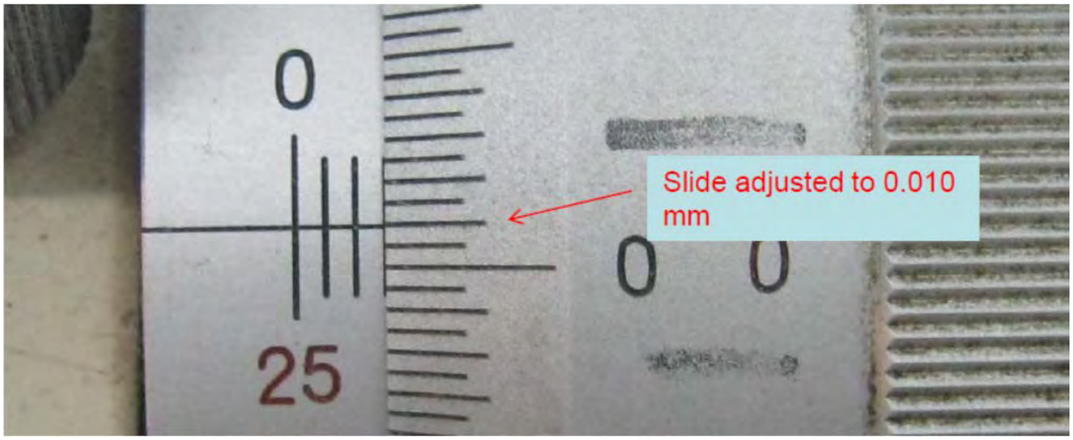


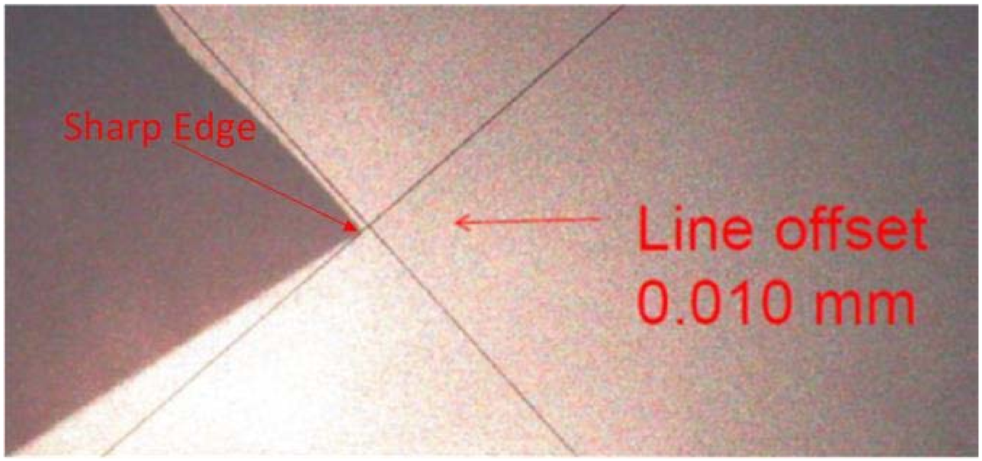


64. The shadowgraph slide can be adjusted 0.005mm, as shown below.



65. Next, for example, the shadowgraph slide can be adjusted to 0.10mm, as shown below.





66. The sharp edge is provided for controlling the formation of deposits at or adjacent an exit of the nozzle passage. For example, Bosch states that its high pressure spray guided piezo injectors such as the Injector found in Mercedes vehicles have "high deposit robustness."

High Pressure injector PDF found at http://www.bosch-mobility-solutions.com/media/en/ubk_europe/db_application/downloads/pdf/antrieb/de_5/gs_datenblatt_piezo_hochdruck_einspritzventil_hdev4_de.pdf.

b. Claim 2

i. Claim 2 recites, "[a]n injector nozzle according to claim 1, wherein the sharp edge acts as a deposit breaking edge to thereby facilitate deposit removal from the injector nozzle."

67. The Injector, found in Mercedes-Benz vehicles, includes a sharp edge that acts as a deposit breaking edge to thereby facilitate deposit removal from the injector nozzle. Bosch advertises that that its injector has "high deposit robustness."

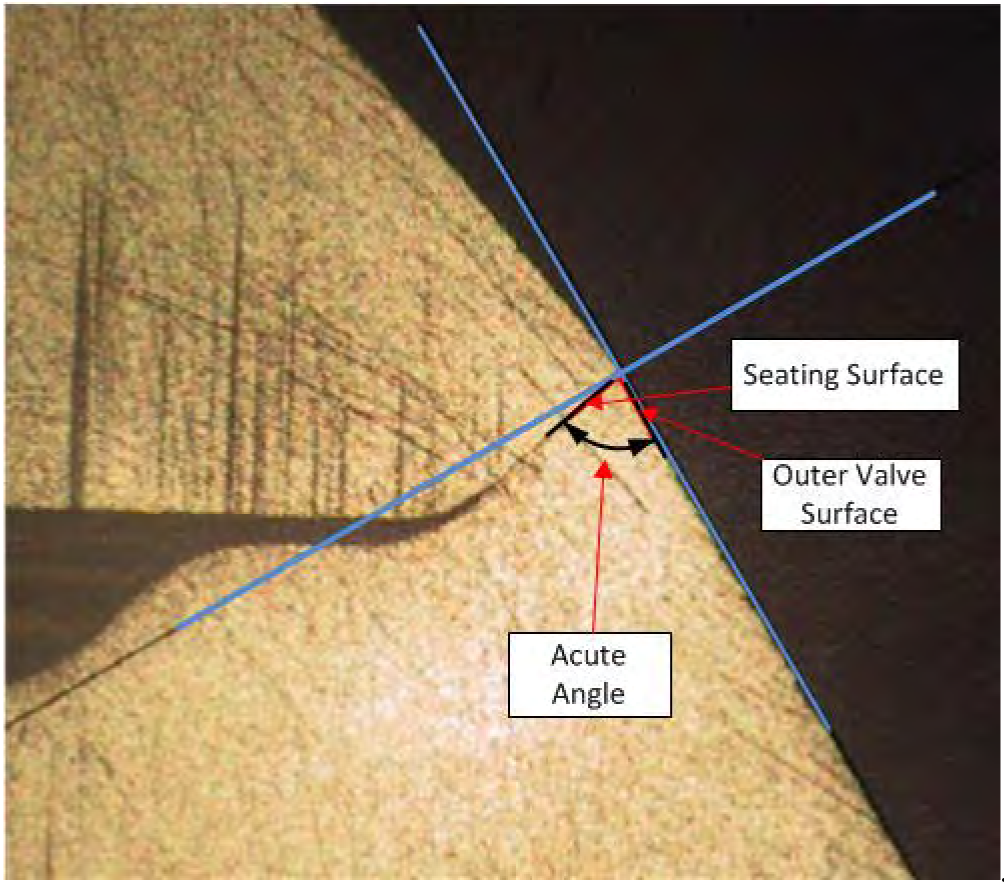
High Pressure injector PDF found at http://www.bosch-mobility-solutions.com/media/en/ubk_europe/db_application/downloads/pdf/antrieb/de_5/gs_datenblatt_piezo_hochdruck_einspritzventil_hdev4_de.pdf.

c. Claim 4

i. Claim 4 recites, "[a]n injector nozzle according to claim 1, wherein an acute angle is provided between the seating surface and the outer valve surface of the valve member at the sharp edge transition."

68. The Injector, found in Mercedes-Benz vehicles, provides an acute angle between the seating surface and the outer surface of the valve member at the sharp edge transition. For example, as shown below on the shadowgraph image of the cut-away Bosch injector, the poppet

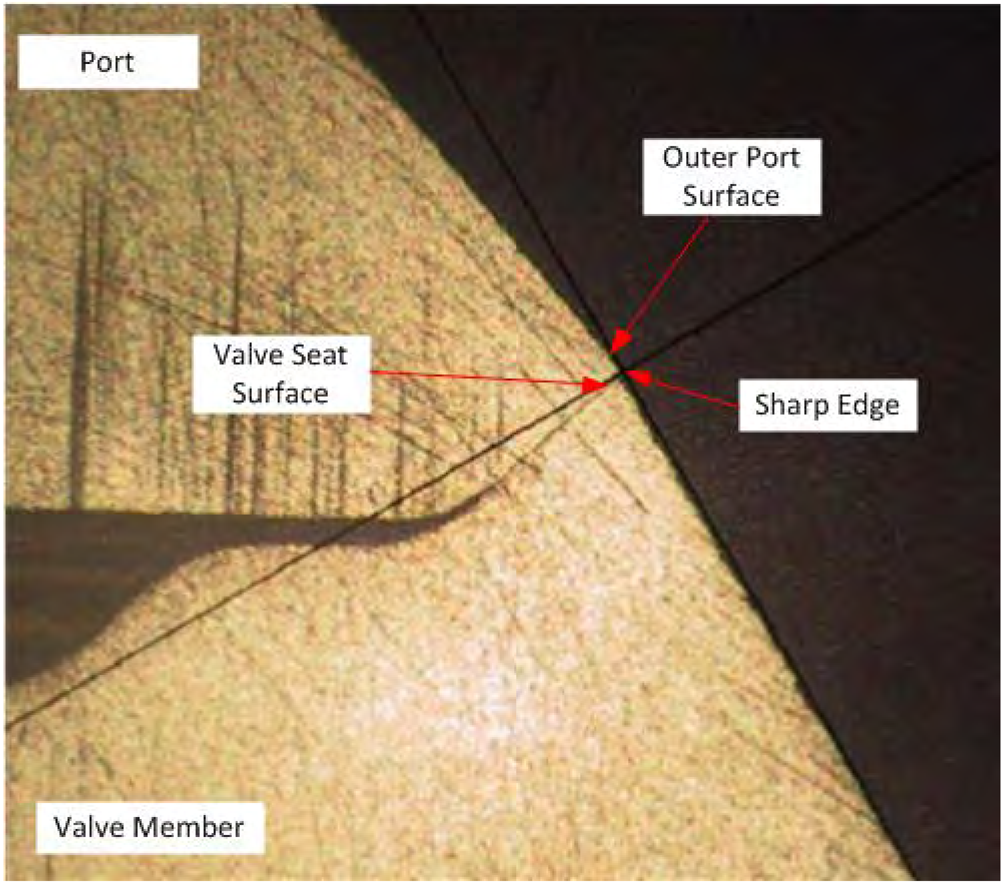
valve member angle to the seat is less than the 90 degree reference lines on the shadowgraph, and therefore acute.



d. Claim 5

i. Claim 5 recites, "[a]n injector nozzle according to claim 1, wherein the port includes an outer port surface surrounding and located adjacent to the valve seat surface, and a sharp edge is provided at the transition between the valve seat surface and the outer port surface."

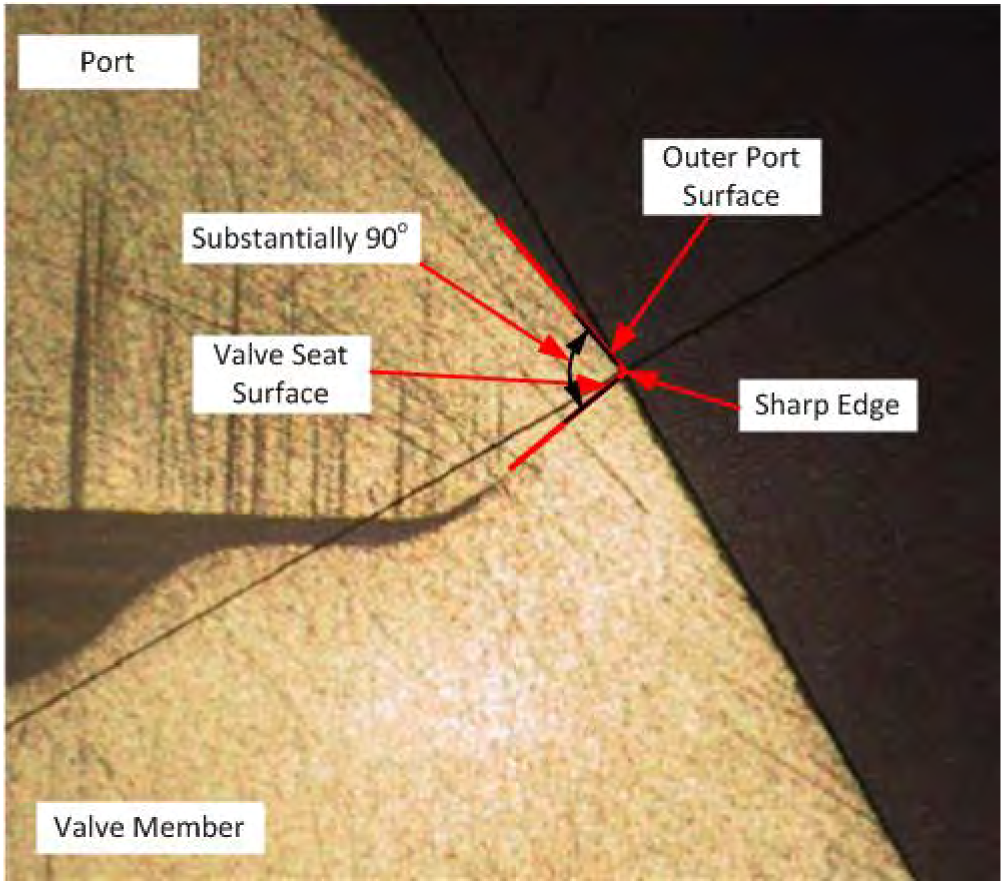
69. The Injector, found in Mercedes-Benz vehicles, includes a sharp edge that is provided between the transition between the valve seat surface and the outer port surface. For example, the shadowgraph image below shows a sharp edge between the valve seat surface and the outer port surface.



e. Claim 6

i. Claim 6 recites, "[a]n injector nozzle according to claim 5, wherein the angle between the valve seat surface and the outer port surface of the port at the sharp edge transition is at least substantially 90 degrees."

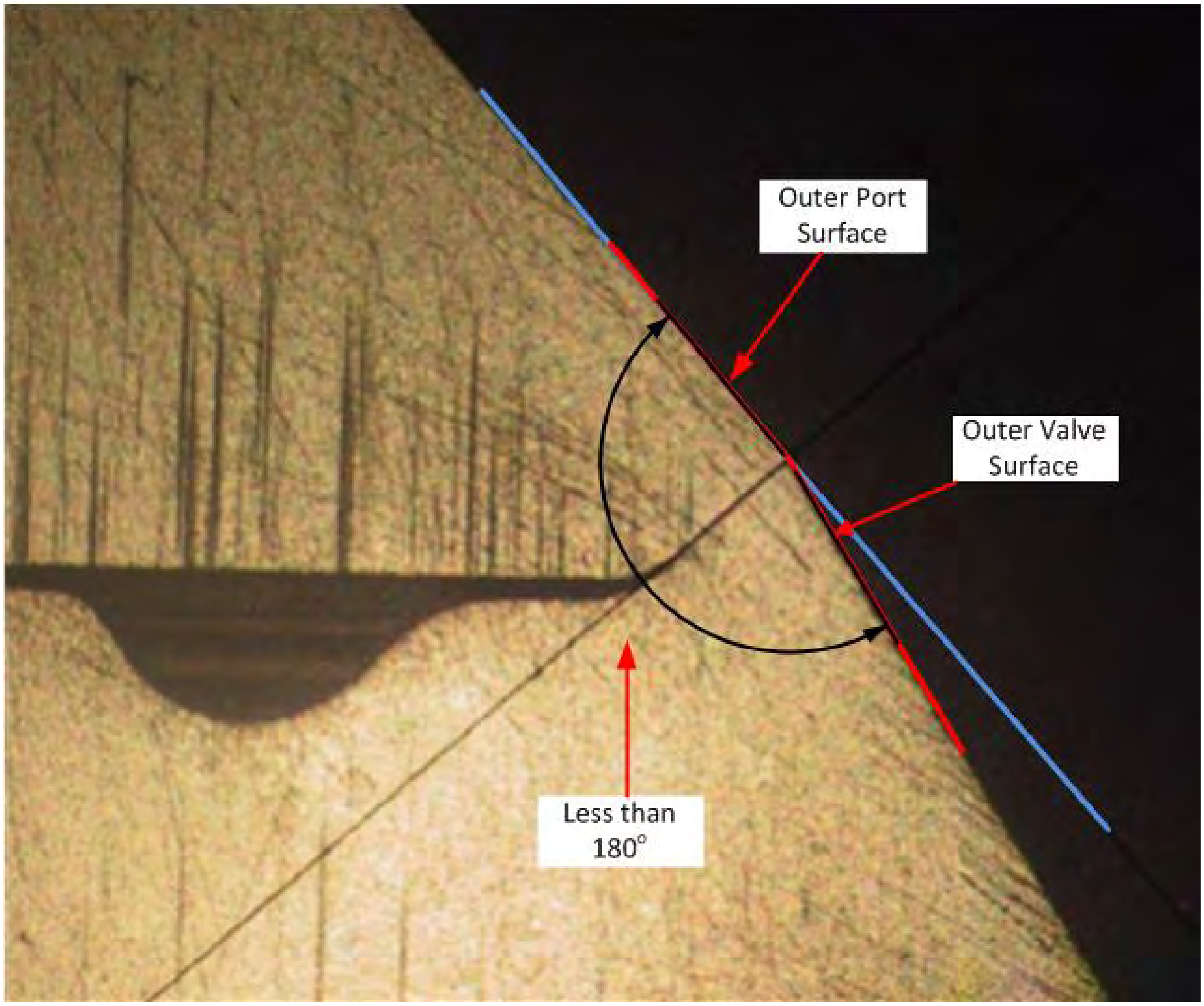
70. The Injector, found in Mercedes-Benz vehicles, provides an angle between the valve seat surface and the outer port surface of the port at the sharp edge transition is at least substantially 90 degrees. For example, as shown below in the shadowgraph image, the reference lines are perpendicular and thus the angle between the valve seat surface and the outer port surface of the port at the sharp edge is substantially 90 degrees.



f. Claim 10

i. Claim 10 recites, "[a]n injector nozzle according to claim 5, wherein the angle between the outer valve surface and the outer port surface is less than 180 degrees."

71. The Injector, found in Mercedes-Benz vehicles, provides an angle between the outer valve surface and the outer port surface that is less than 180 degrees. For example, as shown below in the shadowgraph image, the reference lines show that the angle between the outer valve surface and the outer port surface is less than 180 degrees.



g. Claim 14

i. Claim 14 recites, "[a]n injector nozzle according to claim 1, the nozzle being of the outwardly opening poppet valve type.

72. The Injector, found in Mercedes-Benz vehicles, is an outwardly opening poppet valve type.

High-pressure piezo injector
Gasoline Direct Injection - Fuel injection

Function | Customer benefits

Function of the high-pressure piezo injector

The high-pressure injector is responsible for metering and atomizing the fuel from the fuel rail so that fuel and air are specifically mixed in a certain region of the combustion chamber in order to obtain the best possible combustion of the mixture. To this end, the fuel is concentrated (stratified) in a defined area around the spark plug, depending on the required operating status.

Technical characteristics:

- Outwardly opening piezo fuel injector with directly operated needle
- Spray angle 85° ± 5°
- Large metering range: 0.5 up to 150 mg/stroke at 200 bar (20 MPa)
- System pressure: 200 bar (20 MPa)

Bosch gasoline high pressure piezo injector webpage - http://www.bosch-mobility-solutions.com/en/de/_technik/component/PT_PC_BDI_Fuel-Injection-NEU_PT_PC_Direct-Gasoline-Injection_10181.html?compId=8128#.

h. Claim 15

i. Claim 15 recites, "[a]n injector nozzle according to claim 1, the nozzle being arranged to deliver fuel directly into at least one combustion chamber of the engine."

73. The Injector, found in Mercedes-Benz vehicles, is arranged to deliver fuel directly into at least one combustion chamber of the engine.

High-pressure piezo injector
Gasoline Direct Injection - Fuel injection

Function | **Customer benefits**

Function of the high-pressure piezo injector

The high-pressure injector is responsible for metering and atomizing the fuel from the fuel rail so that fuel and air are specifically mixed in a certain region of the combustion chamber in order to obtain the best possible combustion of the mixture. To this end, the fuel is concentrated (stratified) in a defined area around the spark plug, depending on the required operating status.

Technical characteristics:

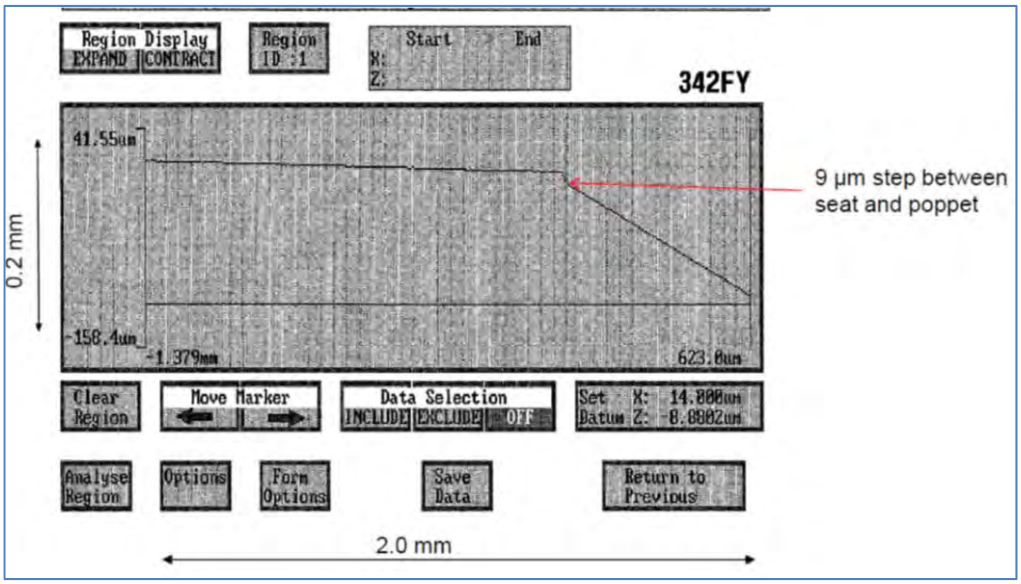
- Outwardly opening piezo fuel injector with directly operated needle
- Spray angle 85° ± 5°
- Large metering range: 0.5 up to 150 mg/stroke at 200 bar (20 MPa)
- System pressure: 200 bar (20 MPa)

Bosch gasoline high pressure piezo injector webpage - http://www.bosch-mobility-solutions.com/en/de/_technik/component/PT_PC_BDI_Fuel-Injection-NEU_PT_PC_Direct-Gasoline-Injection_10181.html?compId=8128#.

i. Claim 16

i. Claim 16 recites, "[a]n injector nozzle according to claim 5, wherein the sharp edge on the valve member is formed in a separate step to the sharp edge on the port."

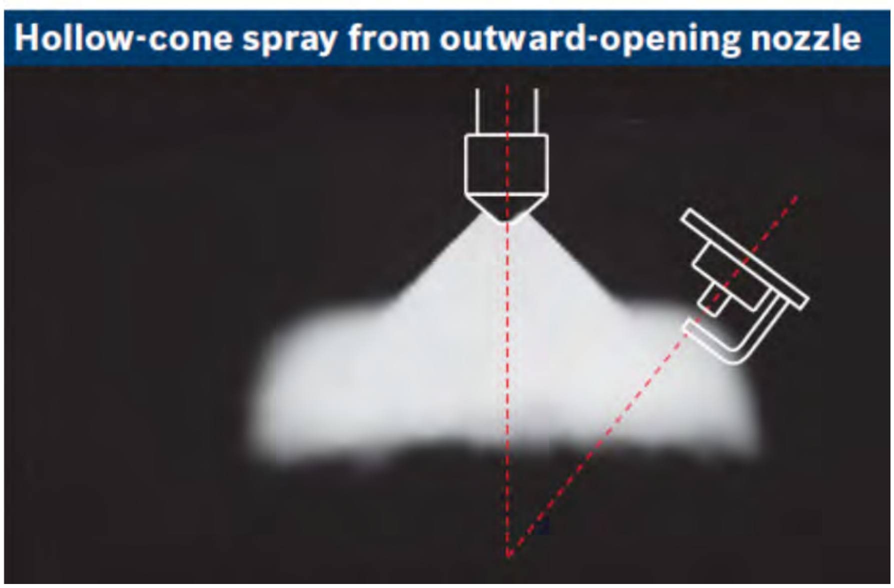
74. The Injector, found in Mercedes-Benz vehicles, includes the sharp edge on the valve member that is formed in a separate step to the sharp edge on port. For example, inspection of the Injector indicates that the seat and poppet valve have been manufactured separately and the external surfaces have not been assembly ground. Inspection with a Talysurf surface and form instrument reveals a step between the seat and poppet of 9 to 11 µm. In addition to the change in angle between the seat and poppet, there is a different appearance in the surface finish from the seat to the poppet.



j. Claim 18

i. Claim 18 recites, "[a]n injector nozzle according to claim 5, wherein the sharp edges on the valve member and on the port facilitates the maintenance of an optimal nozzle exit spray geometry thereby preventing over expansion of the fuel spray at the exit of the nozzle passage."

75. The Injector, found in Mercedes-Benz vehicles, includes the sharp edges on the valve member and on the port that facilitate the maintenance of an optimal nozzle exit spray geometry thereby preventing over expansion of the fuel spray at the exit of the nozzle passage. For example, Bosch states that its high pressure spray guided piezo injectors such as the Injector, found in Mercedes-Benz vehicles, has "symmetrical hollow-cone spray" and "narrow spray tolerances."



High Pressure injector PDF found at http://www.bosch-mobility-solutions.com/media/en/ubk_europe/db_application/downloads/pdf/antrieb/de_5/gs_datenblatt_piezo_hochdruck_einspritzventil_hdev4_de.pdf.

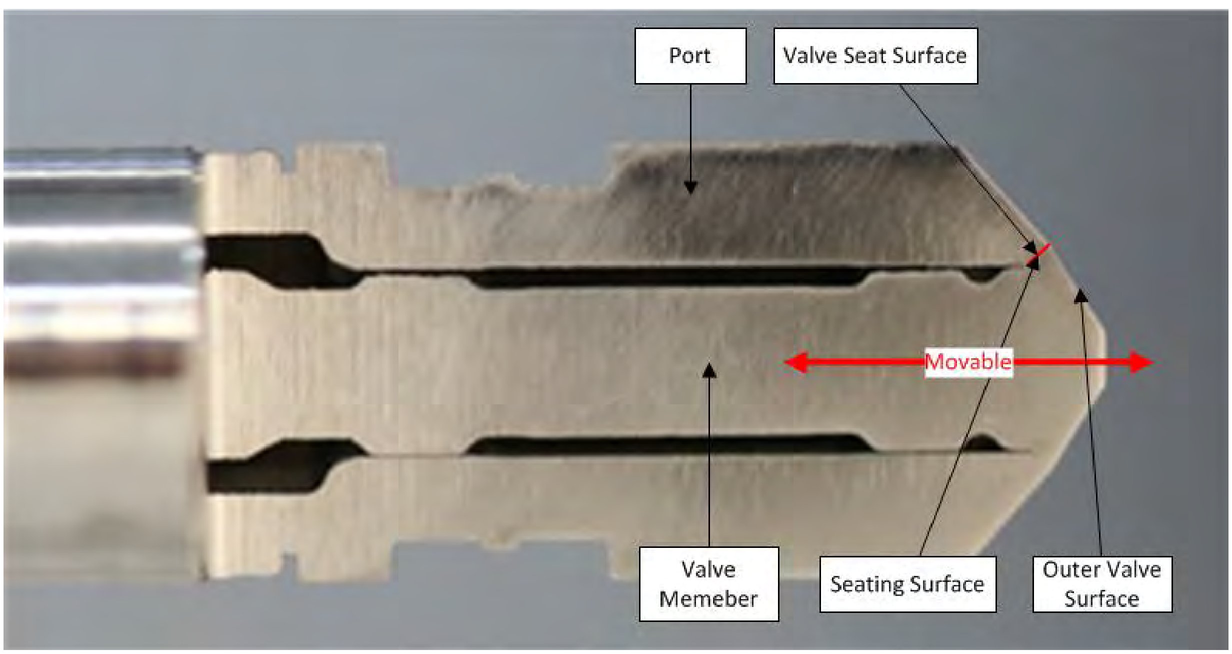
k. Claim 19

i. Claim 19 recites, "[a]n injector nozzle for a spark-ignited fuel injected internal combustion engine operated in stratified charge mode, said injector nozzle including a port having a valve seat surface and valve

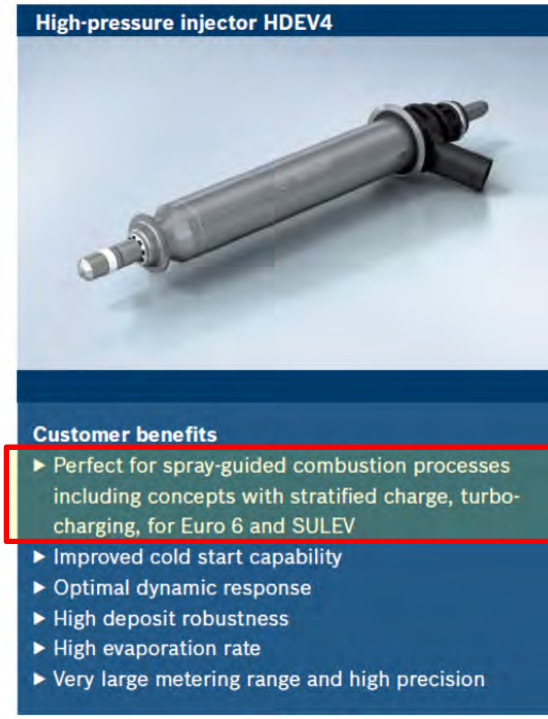
> member having a seating surface, said valve member being movable relative to the port to respectively provide a nozzle passage between the valve seat surface and the seating surface for the delivery of fuel therethrough or sealed contact therebetween to prevent said delivery of fuel, the valve member including an outer valve surface located adjacent the seating surface and external to the port,"

76. The Injector, found in Mercedes-Benz vehicles, includes an injector nozzle for a spark-ignited fuel injected internal combustion engine operated in stratified charge mode, said injector nozzle including a port having a valve seat surface and valve member having a seating surface, said valve member being movable relative to the port to respectively provide a nozzle passage between the valve seat surface and the seating surface for the delivery of fuel therethrough or sealed contact therebetween to prevent said delivery of fuel, the valve member including an outer valve surface located adjacent the seating surface and external to the port.

77. The surfaces of the Injector and nozzle passages can be seen in the photo of the Injector, below, where the injector tip has been cut away to reveal a cross section of the injector nozzle.



78. Further, for example, Bosch states that its injectors are "perfect for spray guided combustion processes including concepts with stratified charge."

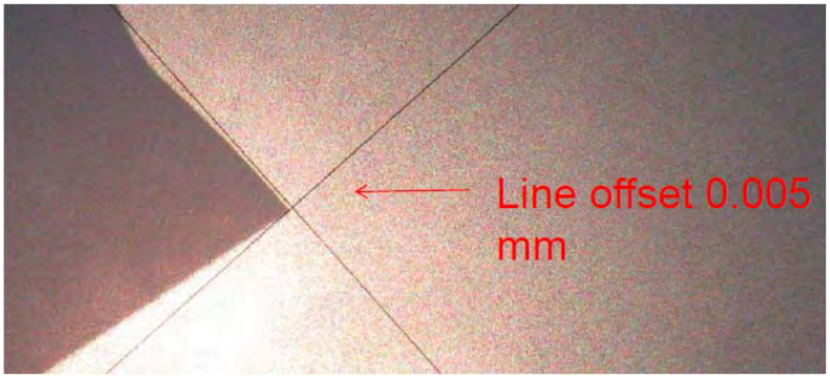


High Pressure injector PDF found at http://www.bosch-mobility-solutions.com/media/en/ubk_europe/db_application/downloads/pdf/antrieb/de_5/gs_datenblatt_piezo_hochdruck_einspritzventil_hdev4_de.pdf.

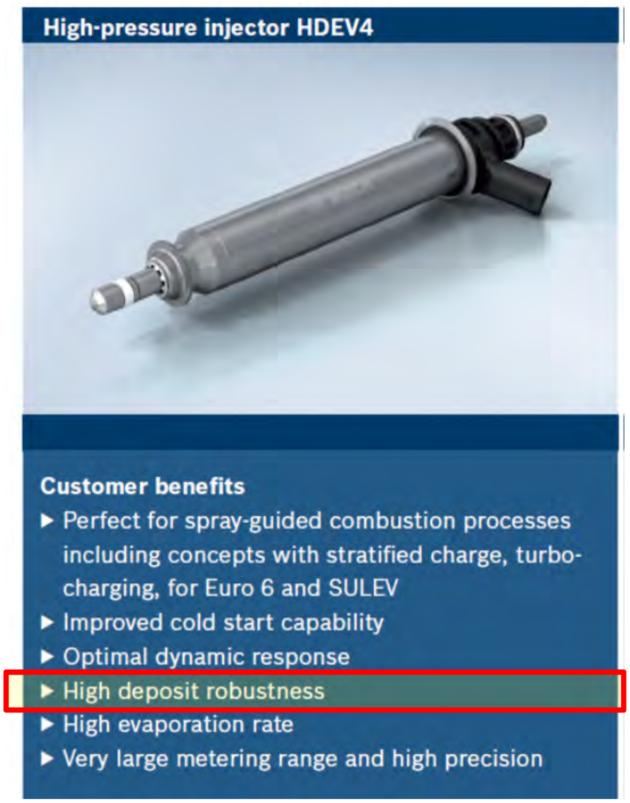
ii. Claim 19 further recites, "wherein a sharp edge is provided on the valve member at the transition between the seating surface and the outer valve surface thereof, for controlling the formation of deposits at or adjacent an exit of the nozzle passage."

79. The Injector, found in Mercedes-Benz vehicles, includes a sharp edge on the valve member at the transition between the seating surface and the outer valve surface thereof, for controlling the formation of deposits at or adjacent an exit of the nozzle passage.

80. The Injector includes a sharp edge on the valve member at the transition between the seating surface and the outer valve surface thereof, as can be seen by the shadow graph image below.



81. Further, Bosch states, for example, that its high pressure spray guided piezo injectors such as the ones found in Mercedes-Benz vehicles have "high deposit robustness."



High Pressure injector PDF found at http://www.bosch-mobility-solutions.com/media/en/ubk_europe/db_application/downloads/pdf/antrieb/de_5/gs_datenblatt_piezo_hochdruck_einspritzventil_hdev4_de.pdf.

COUNT II

Patent Infringement of U.S. Patent No. 5,655,365

82. Orbital re-alleges and incorporates by reference the allegations of paragraphs 1-38 as if fully set forth herein.

83. On August 12, 1997, U.S. Patent No. 5,655,365 (the ’365 patent), entitled “Method of Operating an Internal Combustion Engine” was duly and legally issued by the United States Patent and Trademark Office. The ’365 patent is valid and enforceable.

84. Orbital Australia owns valid right, title, and interest in and to the ’365 patent. The ’365 patent expired on August 12, 2014. However, Orbital remains entitled to collect damages for past infringement occurring during the term of the ’365 patent pursuant to 35 U.S.C §§ 284 and 286.

1. Mercedes

85. In violation of 35 U.S.C. § 271, as more specifically alleged below, each of the Mercedes Defendants, including its affiliates, has directly infringed, either literally or under the doctrine of equivalents, one or more claims of the ’365 patent, by, without limitation, using automobiles that implement control systems, for operating an internal combustion engine, which practice all of the limitations of one or more of the claims of the ’365 patent, within the Eastern District of Virginia and elsewhere within the United States.

86. Mercedes’ acts of infringement during the term of the ’365 patent have caused damage to Orbital, and Orbital is entitled to recover past damages in an amount subject to proof at trial.

2. Direct Infringement of the ’365 Patent

87. Orbital’s current infringement positions are based upon reasonable information and belief. Orbital anticipates collecting additional evidentiary support through the discovery

process. As such, Orbital reserves the right to assert any valid claims of the ’365 patent, against any additional infringing products identified during the discovery process.

88. Mercedes tested and/or operated, at least, the Mercedes automobiles, identified in Exhibit 4, within the United States, in furtherance of sales, during the term of the ’365 patent.

89. Mercedes automobiles implement control systems for operating an internal combustion engine that literally infringe at least claims 1, 2, 5, 9, 10, 12-14, and 18 of the ’365 patent. Specifically, the Mercedes automobiles that include Bosch Motronic control systems for operating an internal combustion engine, literally infringe at least claims 1, 2, 5, 9, 10, 12-14, and 18 of the ’365 patent. Each Mercedes defendant operated Mercedes automobiles and/or engines that use the Bosch control system, and as a result, each Mercedes defendant infringes at least claims 1, 2, 5, 9, 10, 12-14, and 18 of the ’365 patent.

90. While it is Orbital’s position that each Mercedes defendant literally infringed at least the asserted claims of the ’365 patent, in the event defendants allege and/or the Court construes a claim term such that one or more of the defendants may be found not to have literally infringed one or more of the asserted claims of the ’365 patent, Orbital reserves the right to provide additional contentions, regarding infringement under the doctrine of equivalents.

91. The Bosch Motronic control systems are used for engine management, as part of normal engine operation. The Bosch Motronic control systems use hardware and software to monitor and analyze the engine, including its conditions, functions and controls. The Bosch Motronic control systems are also able to electronically control physical engine components. While the hardware of a Bosch Motronic control system and the physical engine components can be physically examined, some information regarding the control strategy carried out by the software in the Bosch Motronic control system cannot be examined without access to the

software source code and/or the use of electronic diagnostic equipment capable of interpreting the Bosch Motronic control system function. Certain information regarding the Bosch Motronic control system and the control of the engine components, however, can be gained from publicly available information and interpreting data collected from electronic diagnostic equipment. Orbital anticipates obtaining additional information regarding the internal electrical and software functions of the Bosch Motronic control system through discovery that will confirm that the use of Bosch control systems in Mercedes vehicles infringes the ’365 patent.

92. Based upon currently available information, during the term of the ’365 patent, the use of Mercedes automobiles including the Bosch Motronic control system, directly infringed at least claims 1, 2, 5, 9, 10, 12-14, and 18 of the ’365 patent, as follows:

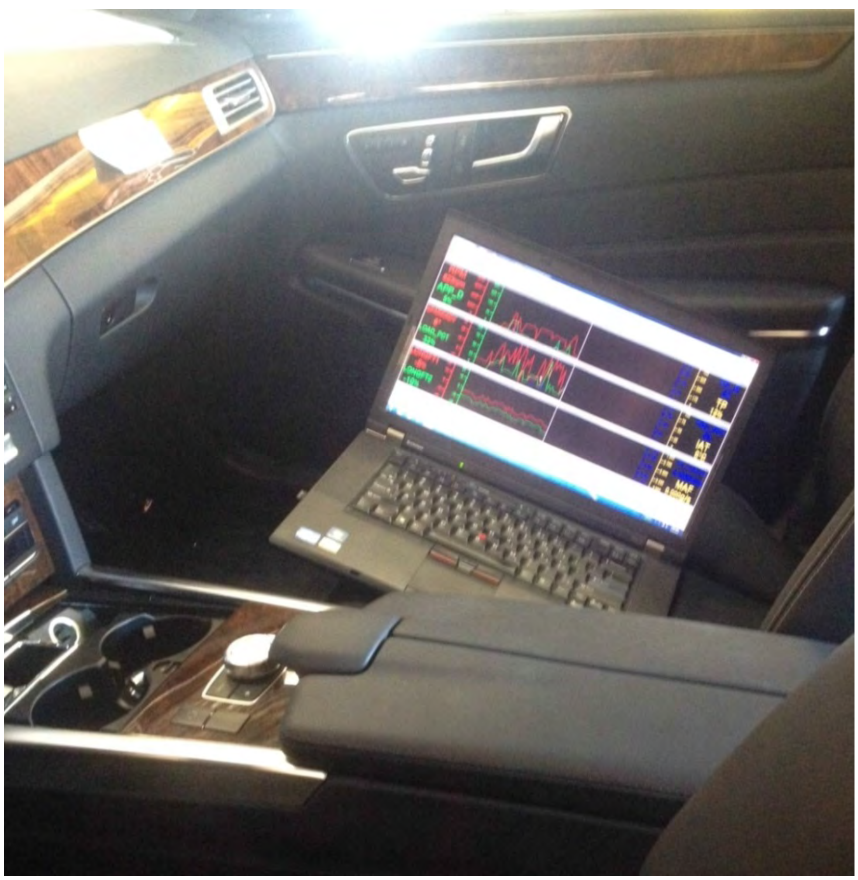
a. Claim 1

i. Claim 1 recites, “[a] method of operating an internal combustion engine comprising retarding the ignition of a gas/fuel mixture within at least one cylinder of the engine to after top dead centre (ATDC) in respect of the combustion cycle of said at least one cylinder of the engine and,”

93. Mercedes-Benz vehicles contain source code, in the engine control unit, that when executed upon operation of the vehicle, perform a method of operating an internal combustion engine comprising retarding the ignition of a gas/fuel mixture within at least one cylinder of the engine to after top dead centre (ATDC) in respect of the combustion cycle of said at least one cylinder of the engine.

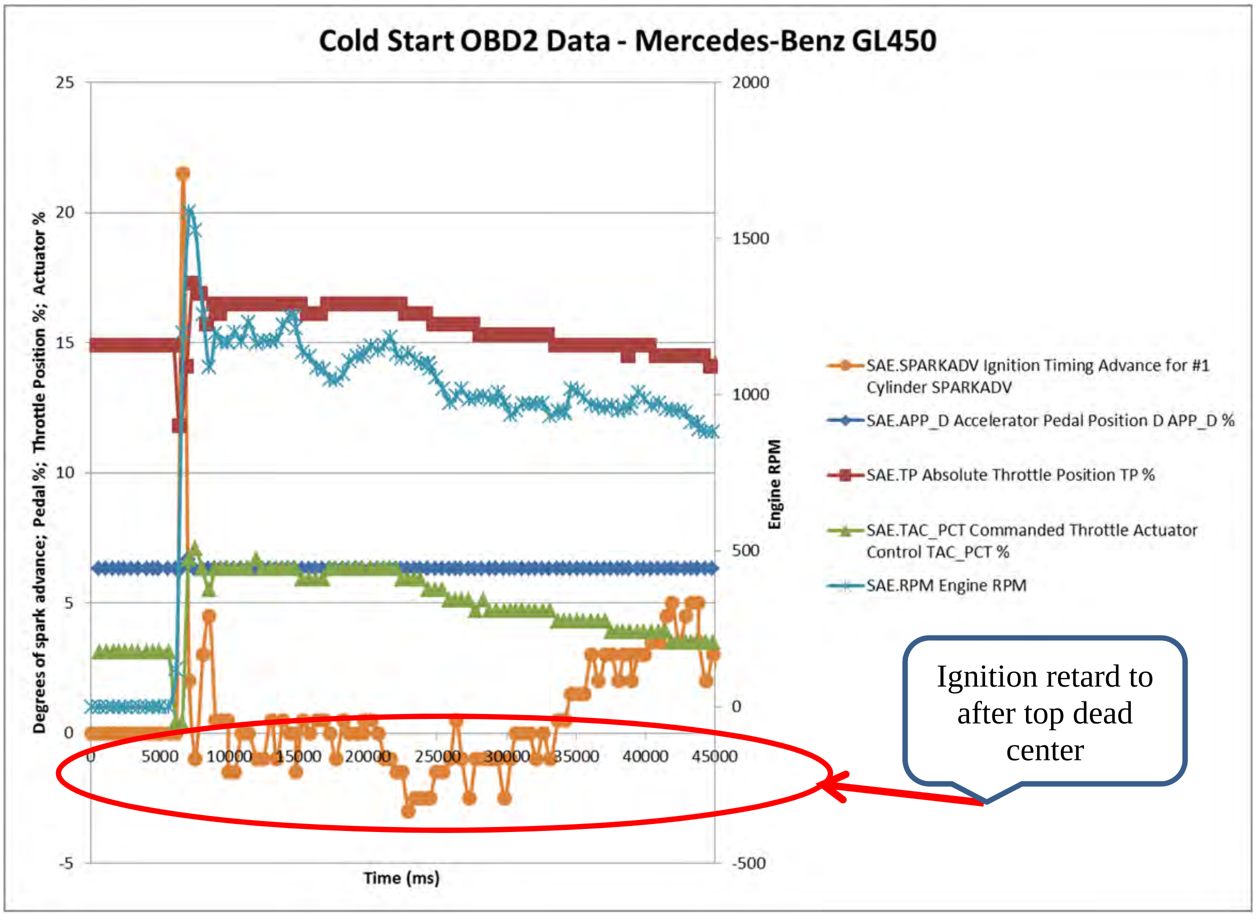
94. For example, test data was obtained from a Mercedes GL450 and a Mercedes E350 with an On-Board Diagnostics (OBD) tool. The OBD tool reads the vehicle data and diagnostic codes through a standard digital communications port located under the dashboard. A commercially available OBD tool such as, for example, the OBDLink MX was utilized to collect data. Images of the tool are shown below.

95. The tool collects data from the vehicle during operation and transmits that data wirelessly to a laptop, as shown below.

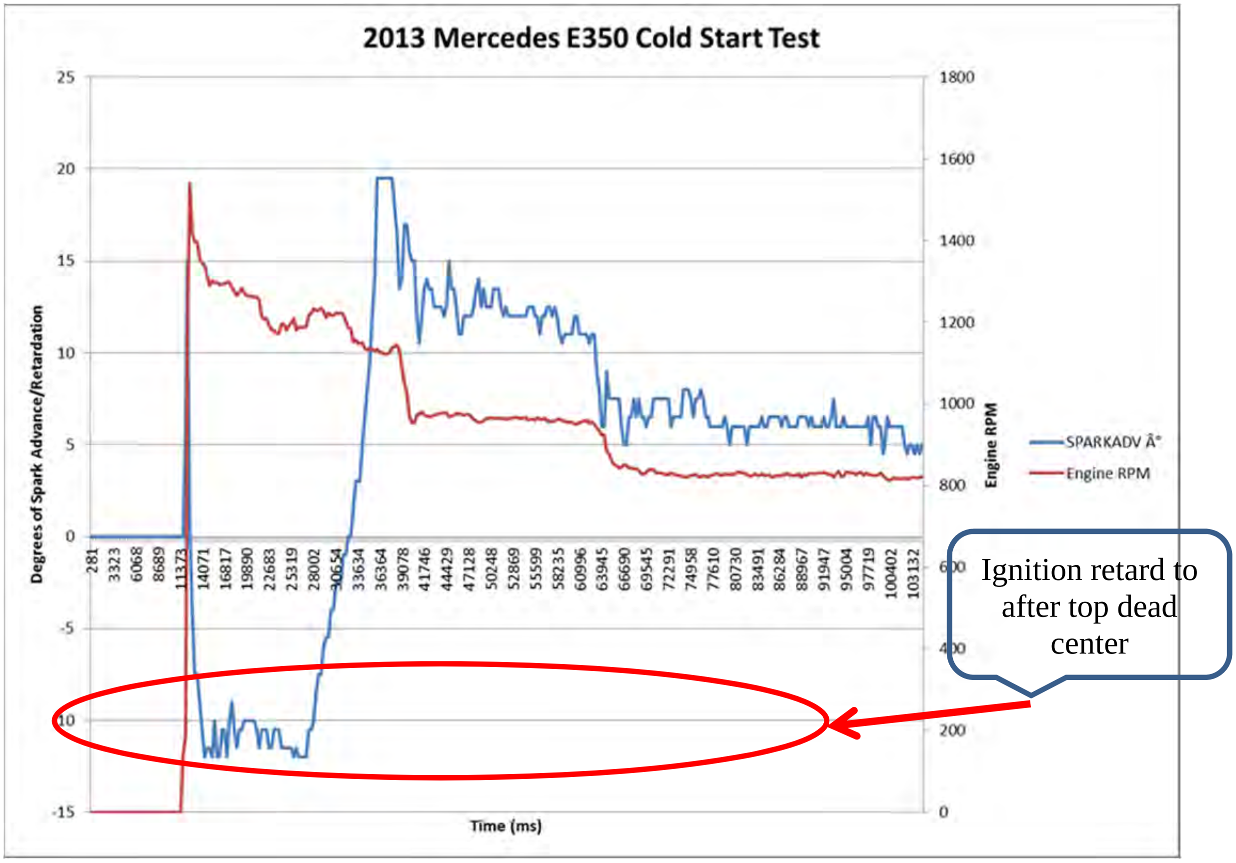


96. The vehicle data was graphed and analyzed with a scan tool software product named ScanXL pro. The actual test data is shown on a control panel screenshot from the laptop used to collect the data from the Mercedes vehicles.

97. The vehicle data was exported to a Microsoft Excel worksheet and plotted, as shown below.



98. The area within the red circle, above, shows negative values of spark advance ignition timing. Negative values of spark advance ignition timing indicate that the ignition point was retarded until after top dead center in the combustion cycle of the at least one cylinder of the engine. Further, negative values of spark advance are seen in the plot of data collected from a 2013 Mercedes-Benz E350.



ii. Claim 1 further recites, "while said ignition is so retarded, increasing the fuelling rate of said at least one cylinder to a level higher than that required when the engine is operating normally to thereby assist in increasing the exhaust gas temperature of the engine,"

99. Mercedes vehicles further perform the step of while said ignition is so retarded, increasing the fuelling rate of said at least one cylinder to a level higher than that required when the engine is operating normally to thereby assist in increasing the exhaust gas temperature of the engine.

100. For example, both data plots above show an increased speed of the engine which requires a higher fueling rate. In addition, Bosch professional automotive information states that the Motronic control system increases the fuelling for starting "roughly 3 to 4 times the full load delivery."

Starting phase
The range from the first combustion to the first time the catalytic-converter-heating speed is exceeded is called the starting phase. An increased fuel quantity is required for engine starting (roughly 3 to 4 times the full-load delivery at approx. 20 °C).

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015 at 98. (Available at http://www.amazon.com/Gasoline-Engine-Management-Professional-Information/dp/3658039639).

101. Additionally, a Bosch automotive handbook states that modern engine management systems can use retarding ignition timing as a method for "swift heating of the catalytic converter." (Bosch Automotive Handbook, 5th Edition at 478). Bosch further states, "the main measure for increasing the exhaust gas heat flow is ignition-timing retardation," as shown below.

Ignition timing
The main measure for increasing the exhaust-gas heat flow is ignition-timing retardation. Combustion is initiated as late as possible and takes place during the expansion phase. The exhaust gas has a relatively high temperature at the end of the expansion phase.
Retarded combustion has an unfavorable effect on engine efficiency.

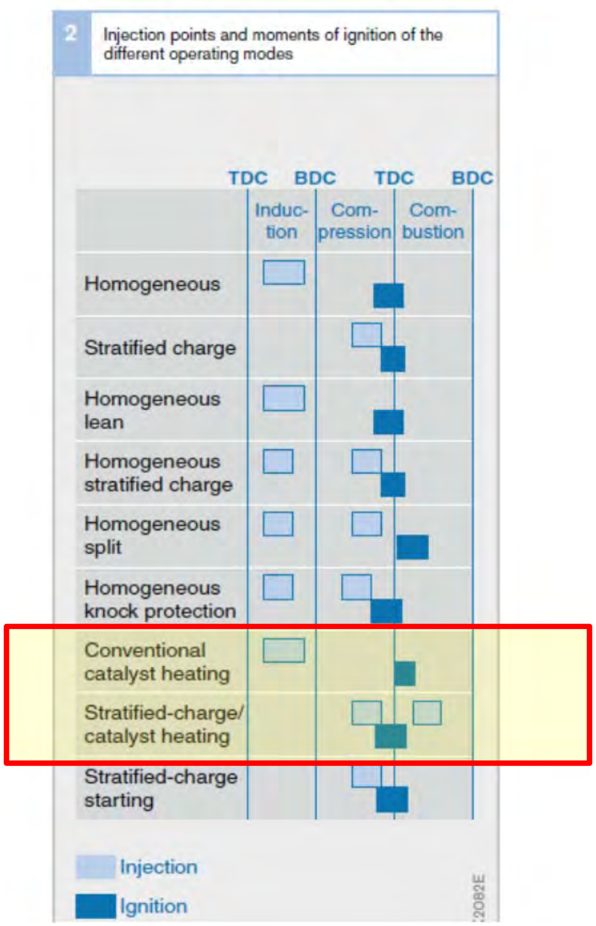
Idle speed
A supporting measure is to raise the idle speed and thereby increase the exhaust-gas mass flow. The increased engine speed permits a greater ignition-timing retardation; however, in order to ensure reliable ignition, the ignition angles are limited to roughly 10° to 15° after TDC. The heat output limited in this way is not always enough to achieve the current emission limits.

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015 at 276.

i. Claim 1 further recites, "the timing of the introduction of fuel into the at least one cylinder being maintained at before top dead centre (BTDC)."

102. Mercedes vehicles further perform the method wherein the timing of the introduction of fuel into the at least one cylinder being maintained at before top dead centre (BTDC).

103. For example, Bosch professional automotive information states that the Motronic control system controls the injection point of fuel during catalyst heating to be before top dead center.



K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015 at 115.

b. Claim 2

i. Claim 2 recites, "[a] method according to claim 1 wherein the fuelling rate is greater than 50% of the fuelling rate at maximum load."

104. Mercedes-Benz vehicles perform a method according to claim 1 wherein the fuelling rate is greater than 50% of the fuelling rate at maximum load.

105. For example, although the ECU source code that determines the fuelling rate is non-public source code that is in the sole possession, custody and control of the Defendants, Bosch professional automotive information states that the Motronic engine management system increases the fuelling for starting "roughly 3 to 4 times the full load delivery."

> *Starting phase*
> The range from the first combustion to the first time the catalytic-converter-heating speed is exceeded is called the starting phase. An increased fuel quantity is required for engine starting (roughly 3 to 4 times the full-load delivery at approx. 20 °C).

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015 at 98.

c. Claim 5

i. Claim 5 recites, "[a] method according claim 1 wherein the ignition is retarded up to about 30° ATDC."

106. Mercedes-Benz vehicles perform a method according to claim 1 wherein the ignition is retarded up to about 30° ATDC.

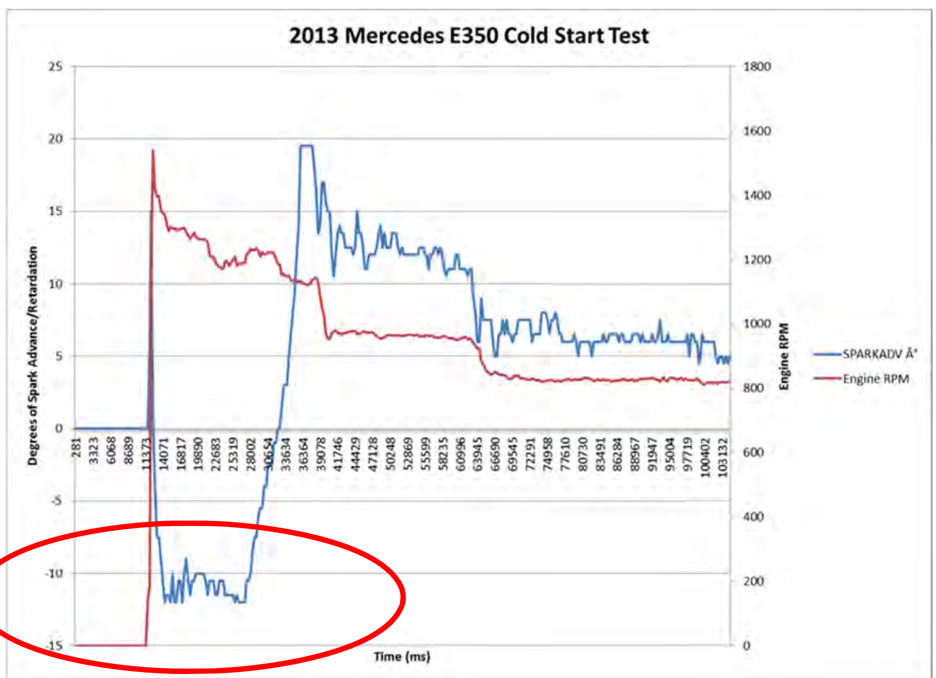
107. For example, Bosch professional automotive information states that the Motronic engine management system retards the ignition to "roughly 10º to 15º ATDC."

Ignition timing
The main measure for increasing the exhaust-gas heat flow is ignition-timing retardation. Combustion is initiated as late as possible and takes place during the expansion phase. The exhaust gas has a relatively high temperature at the end of the expansion phase.
Retarded combustion has an unfavorable effect on engine efficiency.

Idle speed
A supporting measure is to raise the idle speed and thereby increase the exhaust-gas mass flow. The increased engine speed permits a greater ignition-timing retardation; however, in order to ensure reliable ignition, the ignition angles are limited to roughly 10° to 15° after TDC. The heat output limited in this way is not always enough to achieve the current emission limits.

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015 at 276.

108. Further, for example, data collected from a Mercedes vehicle shows that the engine management system retards the ignition to “roughly 10º to 15º ATDC.”

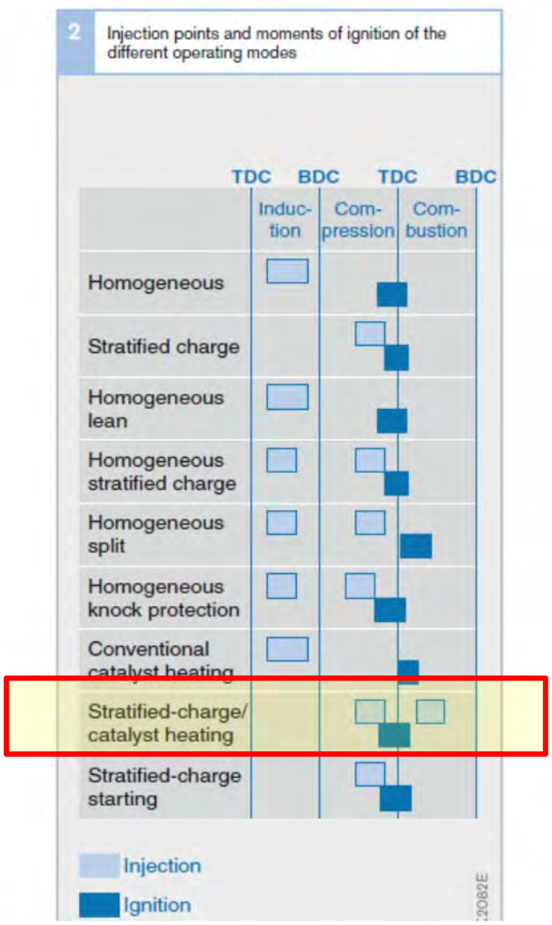


d. Claim 9

i. Claim 9 recites, "[a] method according to claim 1 wherein the fuel is introduced at between 60° to 80° BTDC."

109. Mercedes-Benz vehicles perform a method according to claim 1 wherein the fuel is introduced at between 60° to 80° BTDC.

110. For example, although the control source code that determines the fuelling introduction point is non-public source code that is in the sole possession, custody and control of the Defendants, Bosch professional automotive information shows that the Motronic engine management system controls the injection point of fuel during stratified-charge/catalyst heating to be approximately between 60 to 80 degrees BTDC.



K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015 at 115.

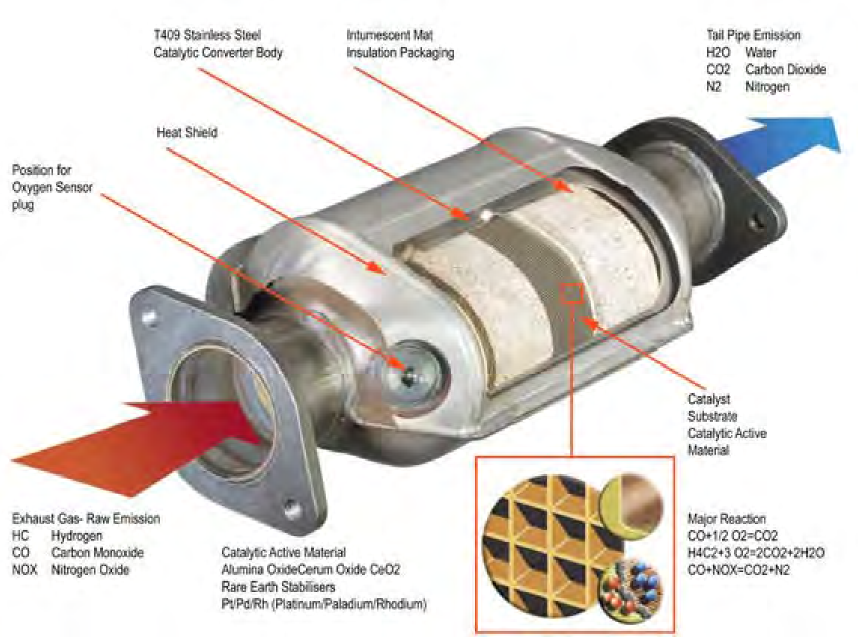
e. Claim 10

i. Claim 10 recites, "[a] method according to claim 1 wherein the engine includes in an exhaust system thereof a catalytic treatment means supporting a catalytic material therein.

111. Mercedes-Benz vehicles include an exhaust system with a catalytic treatment means supporting a catalytic material therein.

112. For example, the Mercedes GL450 includes a catalytic converter in the exhaust system to treat the engine exhaust. (http://epc.startekinfo.com/epc/).

113. An exemplary picture of a catalytic converter is shown below.



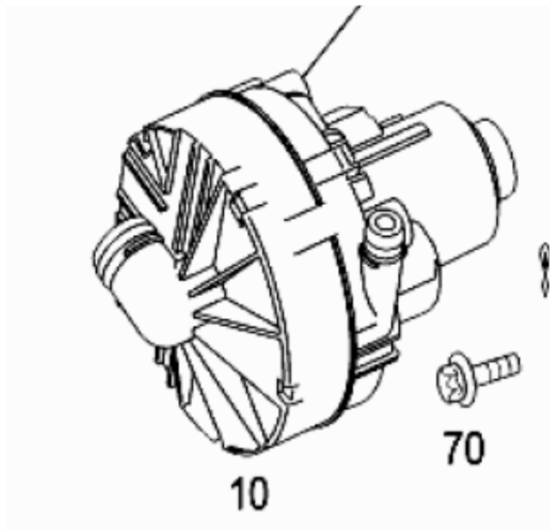
f. Claim 12

i. Claim 12 recites, "[a] method according to claim 10 wherein additional air is introduced upstream of the catalytic treatment means."

114. Mercedes-Benz vehicles introduce additional air upstream of the catalytic treatment means.

115. For example, with regard to the Mercedes GL450, the Mercedes-Benz USA LLC website for its electronic parts catalog lists an air pump which is believed to introduce additional air upstream of the catalytic treatment means. (http://epc.startekinfo.com/epc/).

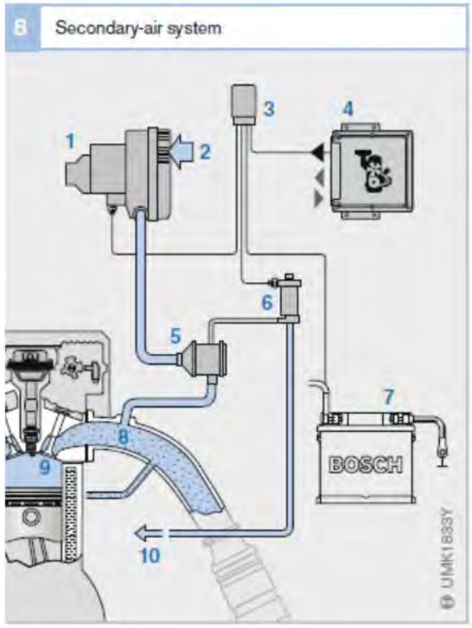
116. A drawing of the air pump for the Mercedes GL450 is shown below.



117. Further for example, Bosch professional automotive information states that a secondary-air pump supplies oxygen to the exhaust system.

> **Secondary-air injection**
> Thermal afterburning of unburnt fuel constituents increases the temperature in the exhaust system. A rich ($\lambda = 0.9$) extending up to a very rich ($\lambda = 0.6$) basic mixture is set for this purpose. A secondary-air pump supplies oxygen to the exhaust system to produce a leaner exhaust-gas composition.

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015 at 277.



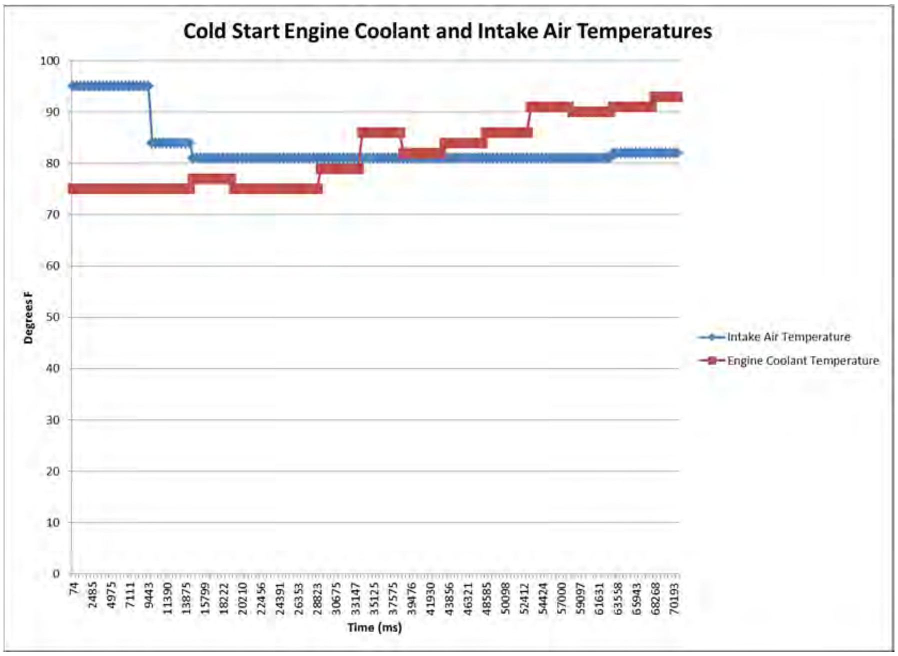
K. Reif (Ed.), *Gasoline Engine Management,* Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015 at 278.

g. Claim 13

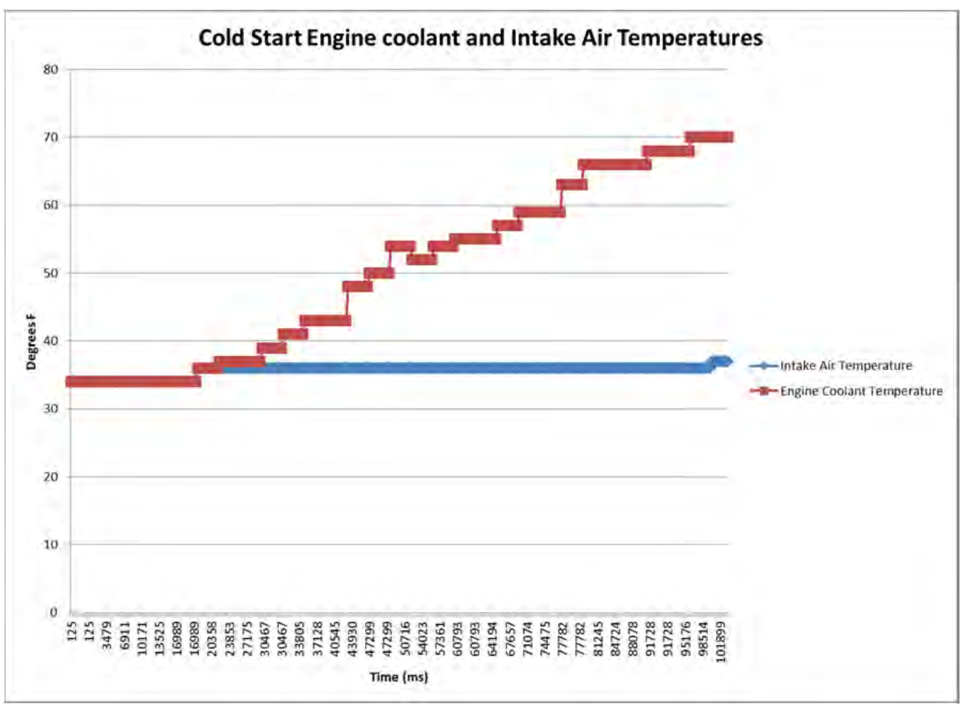
i. Claim 13 recites, "[a] method according to claim 10 wherein the engine is operated according to said method during cold start of the engine."

118. Mercedes-Benz vehicles contain source code that when executed upon operation of the vehicle, perform the method of claim 10 wherein the engine is operated according to the method during cold start of the engine.

119. For example, the test data from a cold start of the Mercedes GL450 engine is shown below. The engine coolant temperature at engine start is near the ambient temperature.



120. Further, for example, the test data from a cold start of a 2013 Mercedes-Benz E350 engine is shown below. The engine coolant temperature at engine start is equal to the ambient temperature.



h. Claim 14

i. Claim 14 recites, "[a] method according to claim 10 wherein the engine is operated according to said method when the temperature of the catalytic material is sensed or determined to be below a required operating temperature."

121. Mercedes-Benz vehicles contain source code that when executed upon operation of the vehicle, perform the method of claim 10 wherein the engine is operated according to the method when the temperature of the catalytic material is sensed or determined to be below a required operating temperature.

122. For example, a Bosch automotive handbook states that modern engine management systems can use retarding ignition timing as a method for "swift heating of the catalytic converter." (Bosch Automotive Handbook, 5th Edition at 478). The Bosch handbook also states that "highly retarded ignition angles generate very hot engine exhaust gas, thereby quickly bringing the catalytic converter up to operating temperature." (Bosch Automotive Handbook, 5th Edition at 505).

123. Further, Bosch professional automotive information states that the catalytic converter must reach roughly 300 degrees C for operation.

Catalytic-converter heating

The three-way catalytic converter must reach a minimum temperature of roughly 300 °C (light-off) before pollutants can be converted; this temperature threshold can be even higher on older catalysts. With the engine and exhaust system initially cold, the catalytic converter must be heated up as quickly as possible to operating temperature. This requires a short-term supply of heat, which can be provided by a variety concepts.

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015 at 276.

i. Claim 18

i. Claim 18 recites, "[a] method according to claim 1 wherein after a predetermined operating condition has been sensed or determined, said engine reverts back to normal operation."

124. Mercedes-Benz vehicles contain source code that when executed upon operation of the vehicle, perform the method of claim 1 wherein after a predetermined operating condition has been sensed or determined, the engine reverts back to normal operation.

125. For example, advancing the spark timing increases power and reduces fuel consumption, therefore the modern electronic engine management systems are programmed to adapt ignition timing in response to factors such as speed, load, and temperature. (Bosch Automotive Handbook, 5th Edition at 479). For example, the previously displayed test data from both the GL450 and the E350 vehicles show ignition retard decrease and revert back to before top dead center as the vehicles warm up.

COUNT III

Patent Infringement of U.S. Patent No. 5,606,951

126. Orbital re-alleges and incorporates by reference the allegations of paragraphs 1-38 as if fully set forth herein.

127. On March 4, 1997, U.S. Patent No. 5,606,951 (the '951 patent), entitled "Engine Air Supply" was duly and legally issued by the United States Patent and Trademark Office. The '951 patent is valid and enforceable.

128. Orbital Australia owns valid right, title, and interest in and to the '951 patent. The '951 patent expired on June 29, 2014. However, Orbital remains entitled to collect damages for past infringement occurring during the term of the '951 patent pursuant to 35 U.S.C §§ 284 and 286.

1. Mercedes

129. In violation of 35 U.S.C. § 271, as more specifically alleged below, each of the Mercedes Defendants, including its affiliates, have directly infringed, either literally or under the doctrine of equivalents, one or more claims of the ’951 patent, by, without limitation, using automobiles which implement a method and/or system to control air supply to an internal combustion engine that practice all of the limitations of one or more of the claims of the ’951 patent, within the Eastern District of Virginia and elsewhere within the United States.

130. Mercedes’ acts of infringement during the term of the patent have caused damage to Orbital, and Orbital is entitled to recover past damages in an amount subject to proof at trial.

2. Direct Infringement of the ’951 Patent

131. Orbital’s current infringement positions are based upon reasonable information and belief. Orbital anticipates collecting additional evidentiary support through the discovery process that will confirm and/or supplement the infringement allegations set forth herein. As such, Orbital reserves the right to assert any valid claims of the ’951 patent against any infringing product identified during discovery.

132. At least one of the Mercedes defendants or its agents tested and/or operated, at least, the Mercedes automobiles, identified in Exhibit 4, within the United States, in furtherance of sales, during the term of the ’951 patent.

133. Mercedes automobiles that implement methods and systems to control air supply to an internal combustion engine literally infringe at least claims 1-10, 12, 14, 15, 23, and 24 of the ’951 patent. Specifically, the Mercedes automobiles that include Bosch Motronic control systems, which control the engine air supply system. When the Bosch Motronic control systems are included in the Mercedes automobiles, the testing and operation of those vehicles in the United States, including by the Mercedes defendants literally infringes at least claims 1-10, 12, 14, 15, 23, and 24 of the ’951 patent.

134. While it is Orbital's position that each Mercedes defendant literally infringed the asserted claims of the '951 patent, in the event defendants allege and/or the Court construes a claim term such that one or more of the defendants may be found not to have literally infringed one or more of the asserted claims of the '951 patent, Orbital reserves the right to provide additional contentions, regarding infringement under the doctrine of equivalents.

135. The Bosch Motronic control systems are used for engine management, as part of normal engine operation. The Bosch Motronic control systems use hardware and software to monitor and analyze the engine, including its conditions, functions and controls. The Bosch Motronic control systems are also able to electronically control physical engine components. While the hardware of a Bosch Motronic control system and the physical engine components can be physically examined, some information regarding the control strategy executed by the software in the Bosch Motronic control system cannot be examined without access to the software source code and/or the use of proprietary electronic diagnostic equipment capable of interpreting the Bosch Motronic control system function. Certain information regarding the Bosch Motronic control system and its use, however, can be gained from publicly available information. The software source code and its functional implementation, with regard to the '951 patent, is unavailable through standard diagnostic techniques. Orbital anticipates obtaining additional information regarding the internal electrical and software functions of the Bosch Motronic control systems and their use through discovery.

136. Based upon currently available information, during the term of the '951 patent, the operation of Mercedes automobiles that included Bosch Motronic control systems directly infringed at least claims 1-10, 12, 14, 15, 23, and 24 of the '951 patent, and the making, using, or

selling of such vehicles directly infringed at least claims 9, 10, 12, 14, and 15 of the ’951 patent as follows:

a. Claim 1

i. Claim 1 recites, “[a] method of controlling the air supply to an internal combustion engine having a means to throttle the air flow to the engine comprising:”

137. Mercedes-Benz vehicles include Bosch Motronic control systems and are programmed to perform, upon operation of the Mercedes-Benz vehicle, a method of controlling the air supply to an internal combustion engine having a means to throttle the air flow to the engine.

138. For example, a Mercedes-Benz vehicle communication software manual from a third party scan tool equipment maker, commonly-used, well-respected, and often relied upon in the automotive industry, describes Mercedes vehicles as having a Motronic engine management system which uses torque-led control. Automotive “torque based control is possible because the electronic accelerator permits throttle valve control beyond the pedal value inputs.”

> The ME-MOTRONIC engine management system uses torque-led control, which means it calculates the internal torque produced during combustion. This is the physical force produced by gas pressure during the compression and power strokes. The actual net torque of the engine has to account for friction, gas transfer losses and drive power for ancillary equipment, such as the water pump, alternator and AC compressor. The ME program contains the optimal specifications for charge density, injection duration, and ignition timing for any desired torque, which makes it possible to obtain optimal emissions and fuel consumption for every operational mode. Operational demands are prioritized and coordinated individually to use the appropriate control to achieve the specified torque. Torque based control is possible because the electronic accelerator permits throttle valve control beyond the pedal value inputs.

https://www1.snapon.com/Files/Diagnostics/UserManuals/MercedesBenzVehicleCommunicationSoftwareManual_EAZ0025B41C.pdf.

Electronic control unit "Motronic"

Gasoline Direct Injection - Engine management

Function Customer benefits

Function of the electronic control unit "Motronic"

The engine control unit collates all the current data on operating status and requirements for the engine, for instance accelerator pedal position and exhaust-system requirements in relation to the mixture composition. Torque is the key criterion for engine management. According to this criterion, the air-fuel ratio is adjusted in such a way that the torque is provided as economically and cleanly as possible. Bosch Motronic also allows active driving safety systems such as TCS and ESP® to intervene in the engine torque.

http://www.bosch-mobility-solutions.com/en/de/_technik/component/PT_PC_BDI_Engine-Management-NEU_PT_PC_Direct-Gasoline-Injection_02_10178.html?compId=8768.

Gasoline Systems
Electronic control unit Motronic

BOSCH
Invented for life

Electronic control unit Motronic

Customer benefits
- Full-line product portfolio for all markets and segments
- Global presence with worldwide local support
- One single, scalable ECU family for different markets and vehicle segments
- Potential for extended functionality
- Flexible integration of customer software

The electronic engine management enables precise, central control of all relevant functions for engine operation. The target is to warrant constant driving behavior and emissions over the engine's useful life.

Task
The electronic control unit collates all requirements on the engine, prioritizes and then implements them. These requirements include, for example, the accelerator pedal position and requirements of the exhaust system on mixture formation.

Function
Torque is used as the key criterion for implementing all requirements. According to this criterion, the air-fuel ratio is adjusted in such a way that the demanded torque is provided as economically and cleanly as possible. It also allows active driving safety systems such as traction control and ESP® to intervene in the engine torque.

Motronic can be used to control internal-combustion engines running on gasoline (port fuel or direct injection), diesel, natural gas (CNG, liquid gas) or ethanol as well as hybrid drives. Standardized communication interfaces and data formats support networking with all vehicle systems which influence the drivetrain.

The electronic control unit variants feature:
- A common platform for gasoline, flex fuel, CNG and diesel applications
- Printed circuit board design
- Diagnostics functions, e.g. for compliance with emission legislation
- Infineon 32 bit microcontroller
- Standardized communication interfaces (CAN, FlexRay, SENT, LIN, K-LINE)
- Highly scalable software and hardware, 4-fold computing power from basic segment to high-end
- Standardized formats to support software sharing and global development (AUTOSAR, MSR)

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Gasoline Systems

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70442 Stuttgart
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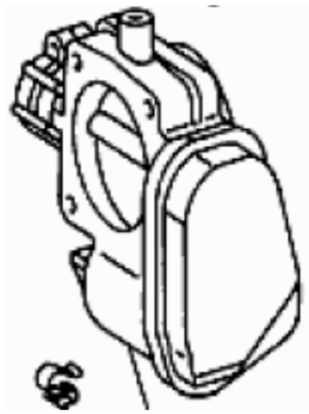
www.bosch-automotivetechnology.com

http://www.bosch-mobility-solutions.com/media/en/ubk_europe/db_application/downloads/pdf/antrieb/de_5/gs_datenblatt_elektronisches_motorsteuergeraet_Motronic_de.pdf.

139. Further, Mercedes-Benz vehicles include an electronic throttle valve to throttle the air flow to the engine. For example, the Mercedes-Benz USA LLC website for its electronic parts catalog specifically lists a throttle valve for the Mercedes GL450, as shown below. (http://epc.startekinfo.com/epc/).



140. Further, for example, Bosch professional automotive information states that the electrically actuated throttle valve throttles the engine "for the purpose of setting a defined air charge." (K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015 at 32).

ii. Claim 1 further recites, "determining the air demand in response to a driver initiated signal;"

141. Mercedes-Benz vehicles include Bosch Motronic control systems and are programmed to, upon operation of the Mercedes-Benz vehicle, determine the air demand in response to a driver initiated signal.

142. For example, certain Mercedes vehicles operate in torque-led mode, which means that the Motronic engine management system determines an optimal air demand in response to the driver pedal value inputs.

The ME-MOTRONIC engine management system uses torque-led control, which means it calculates the internal torque produced during combustion. This is the physical force produced by gas pressure during the compression and power strokes. The actual net torque of the engine has to account for friction, gas transfer losses and drive power for ancillary equipment, such as the water pump, alternator and AC compressor. The ME program contains the optimal specifications for charge density, injection duration, and ignition timing for any desired torque, which makes it possible to obtain optimal emissions and fuel consumption for every operational mode. Operational demands are prioritized and coordinated individually to use the appropriate control to achieve the specified torque. Torque based control is possible because the electronic accelerator permits throttle valve control beyond the pedal value inputs.

https://www1.snapon.com/Files/Diagnostics/UserManuals/MercedesBenzVehicleCommunicationSoftwareManual_EAZ0025B41C.pdf.

Cylinder-charge control systems

In the case of a homogeneously operated gasoline engine with a defined air/fuel ratio λ, the output torque and thus the power is determined by the intake-air mass and the injected fuel quantity. The air mass must be proportioned exactly so that λ can be adhered to precisely.

Electronic throttle control (ETC)

For it to burn, fuel needs oxygen, which the engine takes from the intake air. In engines with external mixture formation (manifold injection), as well as in direct-injection engines operating on a homogeneous mixture, the output torque is directly dependent on the intake-air mass. The engine must therefore be throttled for the purpose of setting a defined air charge.

Function and method of operation

The torque requested by the driver is derived from the position of the accelerator pedal. In the case of the ETC system (Electronic Throttle Control), a position sensor in the accelerator-pedal module (Fig. 1, Pos. 1) records this variable. Further torque requests are derived from functional requests, such as, for example, an additional torque when the air-conditioning system is switched on or a torque reduction during a gearshift.

The Motronic ECU (2) – ME-Motronic for systems with manifold injection or DI-Motronic for gasoline direct injection – calculates the required air mass from the torque to be set and generates the triggering signals for the electrically actuated throttle valve (5). In this way, the opening cross-section and thus the air-mass flow inducted by the gasoline engine are set. Using the feedback information from the throttle-valve-angle sensor (3) regarding the current position of the throttle valve, it then becomes possible to adjust the throttle valve precisely to the required setting.

A cruise-control function can also be easily integrated with ETC. The ECU adjusts the torque in such a way that the vehicle speed preselected at the control element for cruise control is maintained. There is no need to press the accelerator pedal.

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015 at 32.

iii. Claim 1 further recites, "determining an initial position of said throttle means in response to the driver initiated signal;"

143. Mercedes-Benz vehicles include Bosch Motronic control systems and are programmed to, upon operation of the Mercedes-Benz vehicle, determine an initial position of the throttle means in response to the driver initiated signal.

144. For example, although the Bosch Motronic control system source code that determines an initial position of the throttle means in response to the driver initiated signal is non-public source code that is in the sole possession, custody and control of the Defendants, Bosch professional automotive information states that the Motronic engine management system

"calculates the required air mass from the torque to be set and generates the triggering signals for the electrically actuated throttle valve" and that the "torque requested by the driver is derived from the position of the accelerator pedal."

Cylinder-charge control systems

In the case of a homogeneously operated gasoline engine with a defined air/fuel ratio λ, the output torque and thus the power is determined by the intake-air mass and the injected fuel quantity. The air mass must be proportioned exactly so that λ can be adhered to precisely.

Electronic throttle control (ETC)

For it to burn, fuel needs oxygen, which the engine takes from the intake air. In engines with external mixture formation (manifold injection), as well as in direct-injection engines operating on a homogeneous mixture, the output torque is directly dependent on the intake-air mass. The engine must therefore be throttled for the purpose of setting a defined air charge.

Function and method of operation

The torque requested by the driver is derived from the position of the accelerator pedal. In the case of the ETC system (Electronic Throttle Control), a position sensor in the accelerator-pedal module (Fig. 1, Pos. 1) records this variable. Further torque requests are derived from functional requests, such as, for example, an additional torque when the air-conditioning system is switched on or a torque reduction during a gearshift.

The Motronic ECU (2) – ME-Motronic for systems with manifold injection or DI-Motronic for gasoline direct injection – calculates the required air mass from the torque to be set and generates the triggering signals for the electrically actuated throttle valve (5). In this way, the opening cross-section and thus the air-mass flow inducted by the gasoline engine are set. Using the feedback information from the throttle-valve-angle sensor (3) regarding the current position of the throttle valve, it then becomes possible to adjust the throttle valve precisely to the required setting.

A cruise-control function can also be easily integrated with ETC. The ECU adjusts the torque in such a way that the vehicle speed preselected at the control element for cruise control is maintained. There is no need to press the accelerator pedal.

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015 at 32.

iv. Claim 1 further recites, "determining the actual rate of air supply to the engine and comparing said actual rate of air supply with said determined air demand;"

145. Mercedes-Benz vehicles include the Bosch Motronic ECUs and are programmed to, upon operation of the Mercedes-Benz vehicle, determine the actual rate of air supply to the engine and compare said actual rate of air supply with said determined air demand.

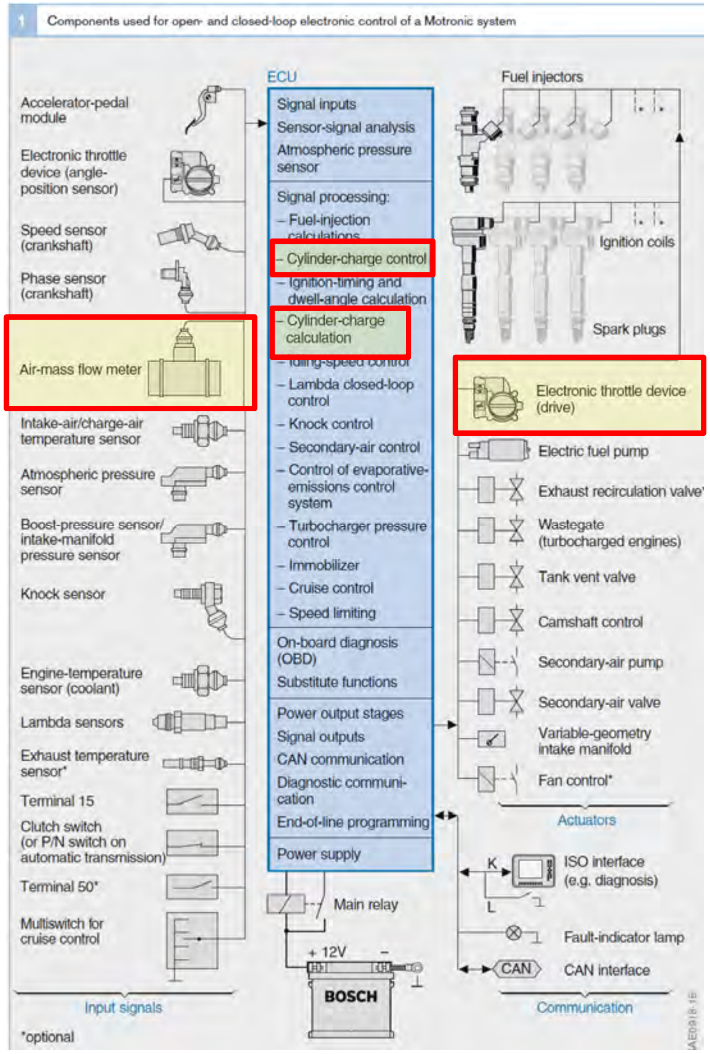
146. For example, Mercedes-Benz vehicles include a mass air flow sensor which is used for feedback to compare the actual rate of air supply with the air demand setpoint.

HOT WIRE AIR MASS
HOT FILM MASS AIR FLOW SENSOR
Range: ____________________ 0 to 500 kg/h

These parameters are an ECU calculation of the mass of the intake air charge in kilograms per hour (kg/h) based on the input of the hot film mass airflow sensor. Normal hot idle values vary depending on engine. In general, readings from 15 to 30 kg/h are normal for a hot engine running at idle with all accessories switched off.

https://www1.snapon.com/Files/Diagnostics/UserManuals/MercedesBenzVehicleCommunicationSoftwareManual_EAZ0025B41C.pdf.

http://www.bosch-mobility-solutions.com/media/en/ubk_europe/db_application/downloads/pdf/antrieb/de_5/gs_datenblatt_heissfilm_luftmassenmesser_de.pdf.



K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015, at 213.

v. Claim 1 further recites, "moving the throttle means to said initial position; and;"

147. Mercedes-Benz vehicles include the Bosch Motronic control systems and are programmed to, upon operation of the Mercedes-Benz vehicle, move the throttle means to the initial position.

148. For example, although the Bosch Motronic control system source code that moves the throttle means to the initial position is non-public source code that is in the sole possession, custody and control of the Defendants, Bosch professional automotive information states that the

Motronic engine management system "calculates the required air mass from the torque to be set and generates the triggering signals for the electrically actuated throttle valve" and that "in this way, the opening cross section and thus the air-mass flow inducted by the gasoline engine are set."

Cylinder-charge control systems

In the case of a homogeneously operated gasoline engine with a defined air/fuel ratio λ, the output torque and thus the power is determined by the intake-air mass and the injected fuel quantity. The air mass must be proportioned exactly so that λ can be adhered to precisely.

Electronic throttle control (ETC)

For it to burn, fuel needs oxygen, which the engine takes from the intake air. In engines with external mixture formation (manifold injection), as well as in direct-injection engines operating on a homogeneous mixture, the output torque is directly dependent on the intake-air mass. The engine must therefore be throttled for the purpose of setting a defined air charge.

Function and method of operation

The torque requested by the driver is derived from the position of the accelerator pedal. In the case of the ETC system (Electronic Throttle Control), a position sensor in the accelerator-pedal module (Fig. 1, Pos. 1) records this variable. Further torque requests are derived from functional requests, such as, for example, an additional torque when the air-conditioning system is switched on or a torque reduction during a gearshift.

The Motronic ECU (2) – ME-Motronic for systems with manifold injection or DI-Motronic for gasoline direct injection – calculates the required air mass from the torque to be set and generates the triggering signals for the electrically actuated throttle valve (5). In this way, the opening cross-section and thus the air-mass flow inducted by the gasoline engine are set. Using the feedback information from the throttle-valve-angle sensor (3) regarding the current position of the throttle valve, it then becomes possible to adjust the throttle valve precisely to the required setting.

A cruise-control function can also be easily integrated with ETC. The ECU adjusts the torque in such a way that the vehicle speed preselected at the control element for cruise control is maintained. There is no need to press the accelerator pedal.

K. Reif (Ed.), *Gasoline Engine Management,* Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015 at 32.

<u>Charge Determination and Pressure Model</u>

Charge determination is important for precise torque calculation. After the cam maps were optimized, charge determination was calibrated. The airflow was back-calculated using measured lambda and measured fuel flow and the necessary maps were adjusted. The next step was to develop the intake manifold pressure model on the engine dynamometer. Over 1200 data points were collected and reduced with a custom Bosch tool to determine the pressure model. The pressure model is used to predict transient airflow to ensure that charge is accurately calculated under all conditions including transients.

McNeil, S., Adamovicz, P., and Lieder, F., "Bosch Motronic MED9.6.1 EMS Applied on a 3.6L DOHC 4V V6 Direct Injection Engine," SAE Technical Paper 2008-01-0133, 2008.

vi. Claim 1 further recites, "adjusting the position of the throttle means to bring the actual rate of air supply within acceptable operating limits of said determined air demand."

149. Mercedes-Benz vehicles include the Bosch Motronic control system and are programmed to, upon operation of the Mercedes-Benz vehicle, adjust the position of the throttle means to bring the actual rate of air supply within acceptable operating limits of said determined air demand.

150. For example, certain Mercedes vehicles utilize mass airflow feedback to adjust the throttle to bring the air supply within acceptable limits.

HOT WIRE AIR MASS
HOT FILM MASS AIR FLOW SENSOR
Range: ____ 0 to 500 kg/h

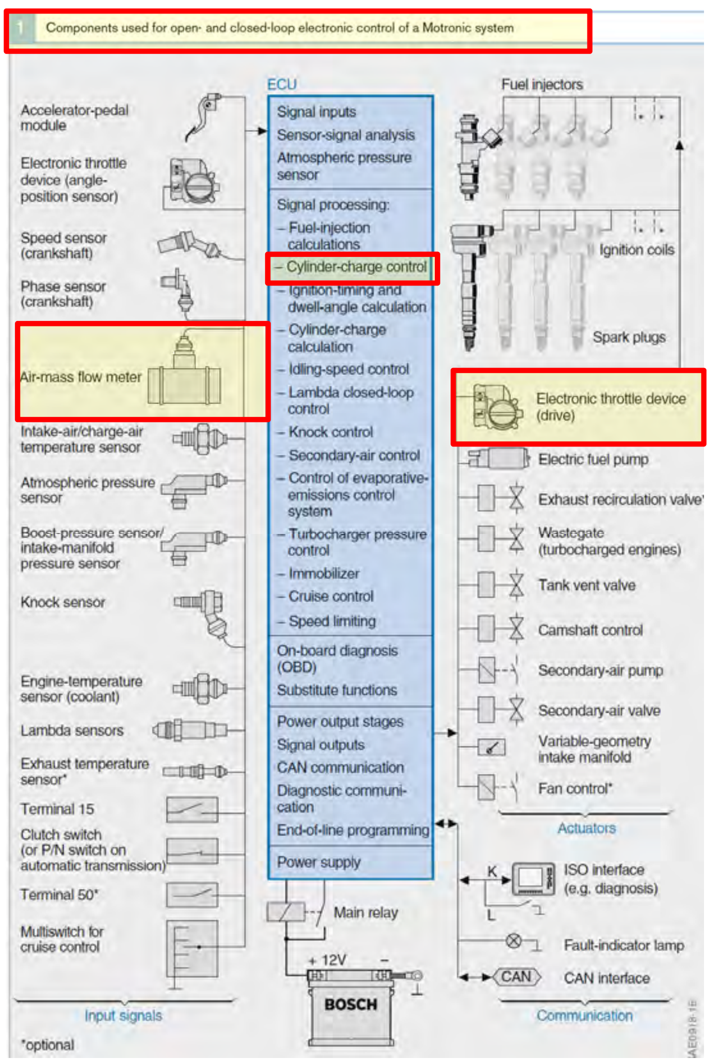
These parameters are an ECU calculation of the mass of the intake air charge in kilograms per hour (kg/h) based on the input of the hot film mass airflow sensor. Normal hot idle values vary depending on engine. In general, readings from 15 to 30 kg/h are normal for a hot engine running at idle with all accessories switched off.

ENGINE LOAD
Range: ______________________________ 0 to 100%

Used on ME10, ME20, ME27, ME28, and SIM4 systems. This parameter is an ECU-calculated engine load displayed as a percentage. The ECU determines engine load based on RPM, number of cylinders, airflow, and cylinder air charge. Input sensor readings are compared to a theoretical air charge that occurs at standard ECU temperature and pressure (volumetric efficiency). The resulting ratio, called engine load, is expressed as a percentage. With the engine running at idle under a normal load readings should be between 20 to 40%. During normal driving, load should be lower than 80%.

The ME-MOTRONIC engine management system uses torque-led control, which means it calculates the internal torque produced during combustion. This is the physical force produced by gas pressure during the compression and power strokes. The actual net torque of the engine has to account for friction, gas transfer losses and drive power for ancillary equipment, such as the water pump, alternator and AC compressor. The ME program contains the optimal specifications for charge density, injection duration, and ignition timing for any desired torque, which makes it possible to obtain optimal emissions and fuel consumption for every operational mode. Operational demands are prioritized and coordinated individually to use the appropriate control to achieve the specified torque. Torque based control is possible because the electronic accelerator permits throttle valve control beyond the pedal value inputs.

https://www1.snapon.com/Files/Diagnostics/UserManuals/MercedesBenzVehicleCommunicationSoftwareManual_EAZ0025B41C.pdf.



K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015, at 213.

6 Components used for open- and closed-loop electronic control of an DI-Motronic system (system diagram)

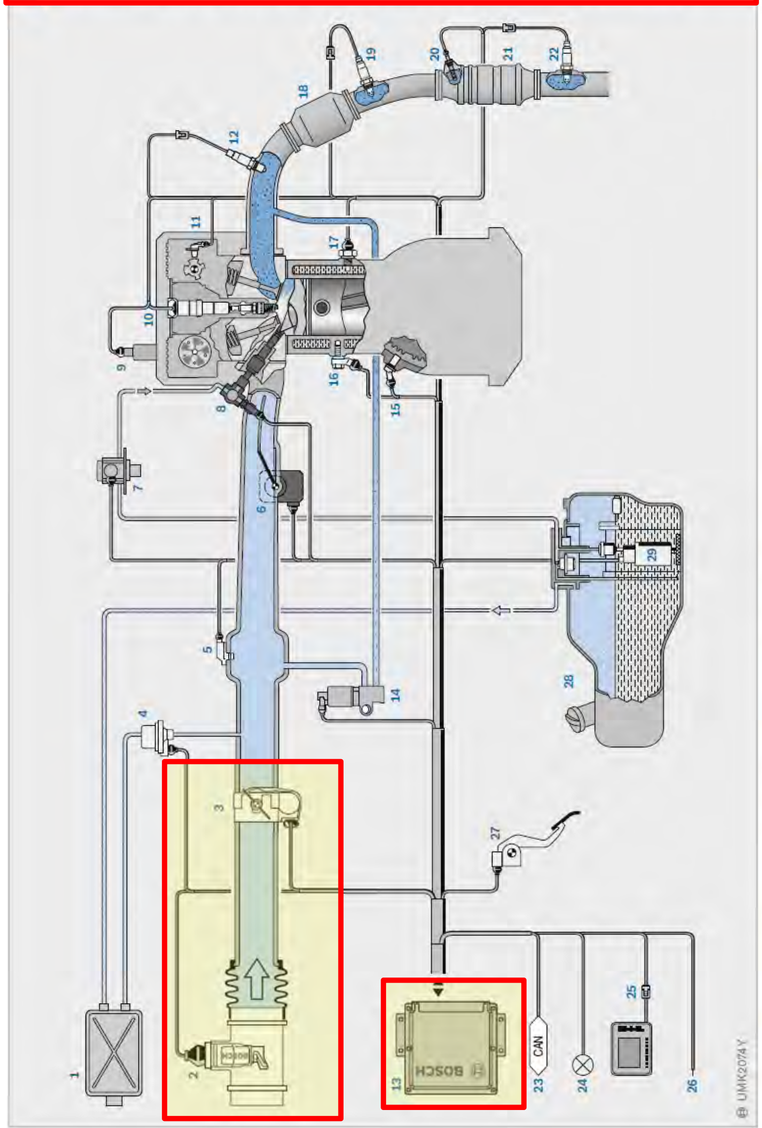


Fig. 6
1 Carbon canister
2 Hot-film air-mass meter
3 Throttle device (ETC)
4 Canister-purge valve
5 Intake-manifold pressure sensor
6 Charge-flow control valve
7 High-pressure pump
8 Fuel rail with high-pressure injector
9 Camshaft adjuster
10 Ignition coil with spark plug
11 Camshaft phase sensor
12 Lambda sensor (LSU)
13 Motronic ECU
14 Exhaust-gas recirculation valve
15 Speed sensor
16 Knock sensor
17 Engine-temperature sensor
18 Primary catalytic converter
19 Lambda sensor
20 Exhaust-gas temperature sensor
21 NO_X accumulator-type catalytic converter
22 Lambda sensor
23 CAN interface
24 Diagnosis lamp
25 Diagnosis interface
26 Interface to immobilizer ECU
27 Accelerator-pedal module
28 Fuel tank
29 Fuel-supply module with electric fuel pump

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015, at 221.

Cylinder-charge control systems

In the case of a homogeneously operated gasoline engine with a defined air/fuel ratio λ, the output torque and thus the power is determined by the intake-air mass and the injected fuel quantity. The air mass must be proportioned exactly so that λ can be adhered to precisely.

Electronic throttle control (ETC)

For it to burn, fuel needs oxygen, which the engine takes from the intake air. In engines with external mixture formation (manifold injection), as well as in direct-injection engines operating on a homogeneous mixture, the output torque is directly dependent on the intake-air mass. The engine must therefore be throttled for the purpose of setting a defined air charge.

Function and method of operation

The torque requested by the driver is derived from the position of the accelerator pedal. In the case of the ETC system (Electronic Throttle Control), a position sensor in the accelerator-pedal module (Fig. 1, Pos. 1) records this variable. Further torque requests are derived from functional requests, such as, for example, an additional torque when the air-conditioning system is switched on or a torque reduction during a gearshift.

The Motronic ECU (2) – ME-Motronic for systems with manifold injection or DI-Motronic for gasoline direct injection – calculates the required air mass from the torque to be set and generates the triggering signals for the electrically actuated throttle valve (5). In this way, the opening cross-section and thus the air-mass flow inducted by the gasoline engine are set. Using the feedback information from the throttle-valve-angle sensor (3) regarding the current position of the throttle valve, it then becomes possible to adjust the throttle valve precisely to the required setting.

A cruise-control function can also be easily integrated with ETC. The ECU adjusts the torque in such a way that the vehicle speed preselected at the control element for cruise control is maintained. There is no need to press the accelerator pedal.

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015 at 32.

b. Claim 2

i. Claim 2 recites, "[t]he method of claim 1 wherein the position of the throttle means is compared with a set point position value and a throttle position actuator is actuated when an actual throttle means position value differs from said set point position value by a greater than acceptable margin to bring said actual position and said set point value into a closer alignment."

151. Mercedes-Benz vehicles include the Bosch Motronic control system and are programmed to, upon operation of the Mercedes-Benz vehicle, compare the position of the throttle means with a set point position value and a throttle position actuator is actuated when an actual throttle means position value differs from said set point position value by a greater than acceptable margin to bring said actual position and said set point value into a closer alignment.

152. For example, the Bosch Motronic engine management system uses "information from the throttle-valve angle sensor regarding the current position of the throttle valve" to "adjust the throttle valve precisely to the required setting."

Cylinder-charge control systems

In the case of a homogeneously operated gasoline engine with a defined air/fuel ratio λ, the output torque and thus the power is determined by the intake-air mass and the injected fuel quantity. The air mass must be proportioned exactly so that λ can be adhered to precisely.

Electronic throttle control (ETC)

For it to burn, fuel needs oxygen, which the engine takes from the intake air. In engines with external mixture formation (manifold injection), as well as in direct-injection engines operating on a homogeneous mixture, the output torque is directly dependent on the intake-air mass. The engine must therefore be throttled for the purpose of setting a defined air charge.

Function and method of operation
The torque requested by the driver is derived from the position of the accelerator pedal. In the case of the ETC system (Electronic Throttle Control), a position sensor in the accelerator-pedal module (Fig. 1, Pos. 1) records this variable. Further torque requests are derived from functional requests, such as, for example, an additional torque when the air-conditioning system is switched on or a torque reduction during a gearshift.

The Motronic ECU (2) – ME-Motronic for systems with manifold injection or DI-Motronic for gasoline direct injection – calculates the required air mass from the torque to be set and generates the triggering signals for the electrically actuated throttle valve (5). In this way, the opening cross-section and thus the air-mass flow inducted by the gasoline engine are set. Using the feedback information from the throttle-valve-angle sensor (3) regarding the current position of the throttle valve, it then becomes possible to adjust the throttle valve precisely to the required setting.

A cruise-control function can also be easily integrated with ETC. The ECU adjusts the torque in such a way that the vehicle speed preselected at the control element for cruise control is maintained. There is no need to press the accelerator pedal.

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015 at 32.

c. Claim 3

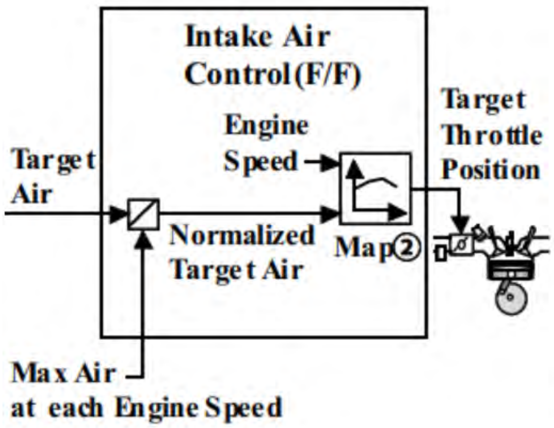
i. Claim 3 recites, "[t]he method of claim 1 wherein said initial position of said throttle means is provided by a look-up map within an engine control unit in accordance with said driver initiated signal."

153. Upon information and belief, Mercedes-Benz vehicles include the Bosch Motronic control system and are programmed to, upon operation of the Mercedes-Benz vehicle, provide the initial position of the throttle means by a look up map with an engine control unit in accordance with the driver initiated signal.

154. For example, although the Bosch Motronic control system source code that provides the initial position of the throttle from a look up map is non-public source code that is in

the sole possession, custody and control of the Defendants, throttle position look up maps are known to be widely used in automotive control systems.

155. An example of an intake throttle position look up map is shown below.



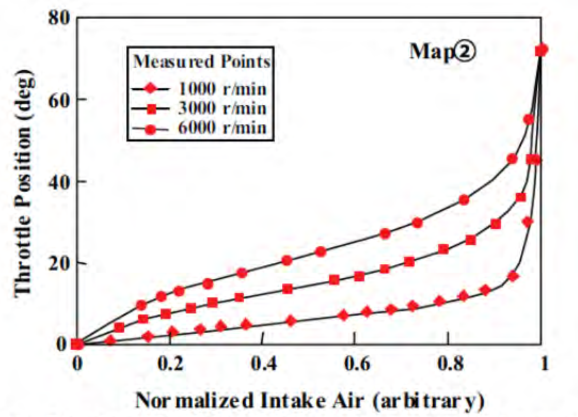


Fig.6 Relationship Between Normalized Intake Air and Throttle Position

Satou, S., Nakagawa, S., Kakuya, H., Minowa, T. et al., "An Accurate Torque-based Engine Control by Learning Correlation between Torque and Throttle Position," SAE Technical Paper 2008-01-1015, 2008.

156. Further, for example, certain types of maps are used in Motronic engine management systems that calculate airflow.

> Charge Determination and Pressure Model
>
> Charge determination is important for precise torque calculation. After the cam maps were optimized, charge determination was calibrated. The airflow was back-calculated using measured lambda and measured fuel flow and the necessary maps were adjusted. The next step was to develop the intake manifold pressure model on the engine dynamometer. Over 1200 data points were collected and reduced with a custom Bosch tool to determine the pressure model. The pressure model is used to predict transient airflow to ensure that charge is accurately calculated under all conditions including transients.

McNeil, S., Adamovicz, P., and Lieder, F., "Bosch Motronic MED9.6.1 EMS Applied on a 3.6L DOHC 4V V6 Direct Injection Engine," SAE Technical Paper 2008-01-0133, 2008.

d. Claim 4

i. Claim 4 recites, "[t]he method of claim 1 wherein said initial position is an acceptable range of position values."

157. Mercedes-Benz vehicles include the Bosch Motronic control systems and are programmed to, upon operation of the Mercedes-Benz vehicle, perform the method of claim 1 wherein the initial position is an acceptable range of position values.

158. For example, although the Bosch Motronic control system source code that relates to the initial position acceptable range of position values is non-public source code that is in the sole possession, custody and control of the Defendants, acceptable ranges of position values are known to be used in automotive control systems.

e. Claim 5

i. Claim 5 recites, "[t]he method of claim 1 wherein said driver initiated signal is an accelerator pedal position."

159. Mercedes-Benz vehicles include the Bosch Motronic control systems and are programmed to, upon operation of the Mercedes-Benz vehicle, perform the method of claim 1, wherein the driver initiated signal is an accelerator pedal position.

160. For example, certain Mercedes vehicles operate in torque-led mode, which means that the control system determines an optimal air demand in response to the driver pedal value inputs.

ENGINE LOAD

Range: ____ 0 to 100%

Used on ME10, ME20, ME27, ME28, and SIM4 systems. This parameter is an ECU-calculated engine load displayed as a percentage. The ECU determines engine load based on RPM, number of cylinders, airflow, and cylinder air charge. Input sensor readings are compared to a theoretical air charge that occurs at standard ECU temperature and pressure (volumetric efficiency). The resulting ratio, called engine load, is expressed as a percentage. With the engine running at idle under a normal load readings should be between 20 to 40%. During normal driving, load should be lower than 80%.

The ME-MOTRONIC engine management system uses torque-led control, which means it calculates the internal torque produced during combustion. This is the physical force produced by gas pressure during the compression and power strokes. The actual net torque of the engine has to account for friction, gas transfer losses and drive power for ancillary equipment, such as the water pump, alternator and AC compressor. The ME program contains the optimal specifications for charge density, injection duration, and ignition timing for any desired torque, which makes it possible to obtain optimal emissions and fuel consumption for every operational mode. Operational demands are prioritized and coordinated individually to use the appropriate control to achieve the specified torque. Torque based control is possible because the electronic accelerator permits throttle valve control beyond the pedal value inputs.

https://www1.snapon.com/Files/Diagnostics/UserManuals/MercedesBenzVehicleCommunicationSoftwareManual_EAZ0025B41C.pdf.

161. Further, for example, Bosch Professional Automotive Information states that "the torque requested by the driver is derived from the position of the accelerator pedal."

Cylinder-charge control systems

In the case of a homogeneously operated gasoline engine with a defined air/fuel ratio λ, the output torque and thus the power is determined by the intake-air mass and the injected fuel quantity. The air mass must be proportioned exactly so that λ can be adhered to precisely.

Electronic throttle control (ETC)

For it to burn, fuel needs oxygen, which the engine takes from the intake air. In engines with external mixture formation (manifold injection), as well as in direct-injection engines operating on a homogeneous mixture, the output torque is directly dependent on the intake-air mass. The engine must therefore be throttled for the purpose of setting a defined air charge.

Function and method of operation

The torque requested by the driver is derived from the position of the accelerator pedal. In the case of the ETC system (Electronic Throttle Control), a position sensor in the accelerator-pedal module (Fig. 1, Pos. 1) records this variable. Further torque requests are derived from functional requests, such as, for example, an additional torque when the air-conditioning system is switched on or a torque reduction during a gearshift.

The Motronic ECU (2) – ME-Motronic for systems with manifold injection or DI-Motronic for gasoline direct injection – calculates the required air mass from the torque to be set and generates the triggering signals for the electrically actuated throttle valve (5). In this way, the opening cross-section and thus the air-mass flow inducted by the gasoline engine are set. Using the feedback information from the throttle-valve-angle sensor (3) regarding the current position of the throttle valve, it then becomes possible to adjust the throttle valve precisely to the required setting.

A cruise-control function can also be easily integrated with ETC. The ECU adjusts the torque in such a way that the vehicle speed preselected at the control element for cruise control is maintained. There is no need to press the accelerator pedal.

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015 at 32.

f. Claim 6

i. Claim 6 recites, "[t]he method of claim 1 wherein said initial position of said throttle means is compensated for changes in engine operating conditions and parameters enabling said initial position of the throttle means to more closely approximate the position corresponding to said determined air demand of the engine over time."

162. Mercedes-Benz vehicles include the Bosch Motronic control systems and are programmed to, upon operation of the Mercedes-Benz vehicle, perform the method of claim 1, wherein said initial position of said throttle means is compensated for changes in engine operating conditions and parameters enabling said initial position of the throttle means to more closely approximate the position corresponding to said determined air demand of the engine over time.

163. For example, although the Bosch Motronic control system source code that compensates the initial position of the throttle for changes in engine operating conditions is non-public source code that is in the sole possession, custody and control of the Defendants, Bosch professional automotive information states that Motronic engine management systems monitor the engine operating data for open and closed loop control of the engine. It also states that the throttle is an actuator component of the control system of the engine.

Acquisition of operating data

Sensor and setpoint generators

Motronic uses sensors and setpoint generators to collect the operating data required for open- and closed-loop control of the engine (Fig. 1).

Setpoint generators (e.g., switches) record settings made by the driver, such as

- The position of the ignition key in the ignition lock (terminal 15)
- The positions of A/C-control switches
- The cruise-control lever setting

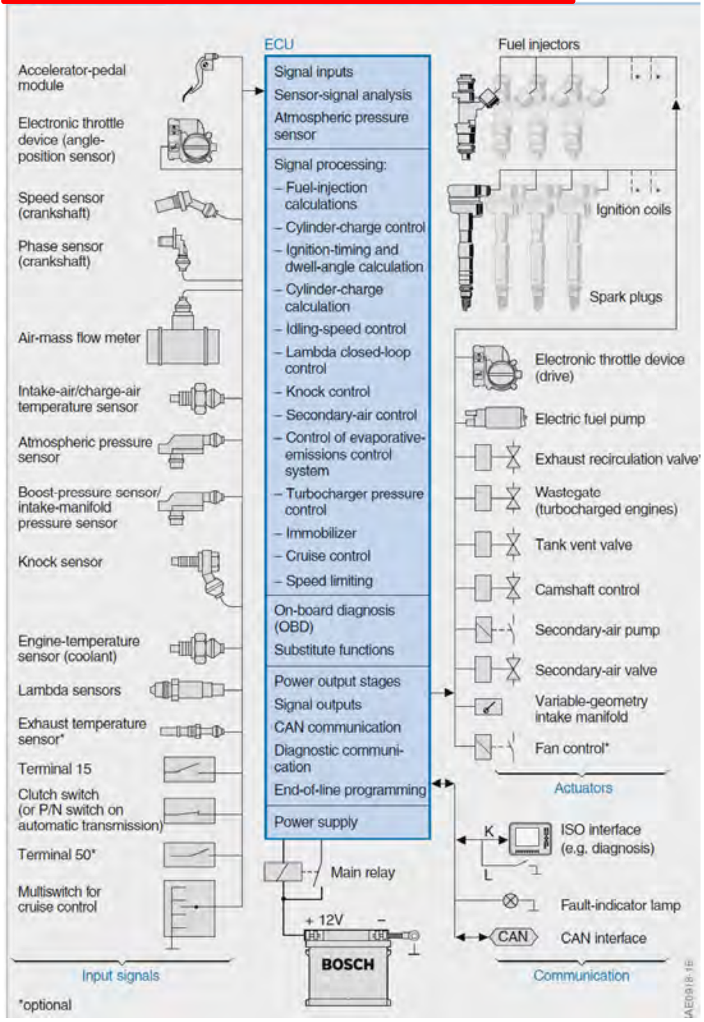
Sensors detect physical and chemical variables, thus providing information about the engine's current operating state.

Examples of such sensors are:

- Engine-speed sensor for detecting the crankshaft position and calculating the engine speed
- Phase sensor for detecting the phase angle (engine operating cycle) or the camshaft position
- Engine-temperature sensor and intake-air temperature sensor for calculating temperature-dependent correction variables
- Knock sensor for detecting engine knock
- Air-mass meter, and/or
- Intake-manifold pressure sensor for charge recording
- Lambda oxygen sensor for lambda closed-loop control

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015, at 212.

1 Components used for open- and closed-loop electronic control of a Motronic system



K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015, at 213.

- A model is used to calculate the charge drawn in by the cylinder from the engine speed (*n*), the pressure (*p*) in the intake manifold (i.e., before the intake valve), the temperature in the intake passage and further additional information (e.g., camshaft/valve-lift adjustment, intake-manifold changeover, position of the swirl control valve) (*p/n* system). Sophisticated models may be necessary, depending on the complexity of the engine, particularly with regard to the variabilities of the valve gear.

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015, at 15.

g. Claim 7

i. Claim 7 recites, "[t]he method of claim 6 wherein said initial position of said throttle means is compensated for engine to engine variations."

164. Mercedes-Benz vehicles include the Bosch Motronic control systems and are programmed to, upon operation of the Mercedes-Benz vehicle, perform the method of claim 6, wherein said initial position of said throttle means is compensated for engine to engine variations.

165. For example, although the Bosch Motronic control system source code that compensates the initial position of the throttle for engine to engine variations is non-public source code that is in the sole possession, custody and control of the Defendants, Bosch professional automotive information states that Motronic engine management systems monitor the engine operating data for open and closed loop control of the engine. It also states that the throttle is an actuator component of the control system of the engine.

Acquisition of operating data

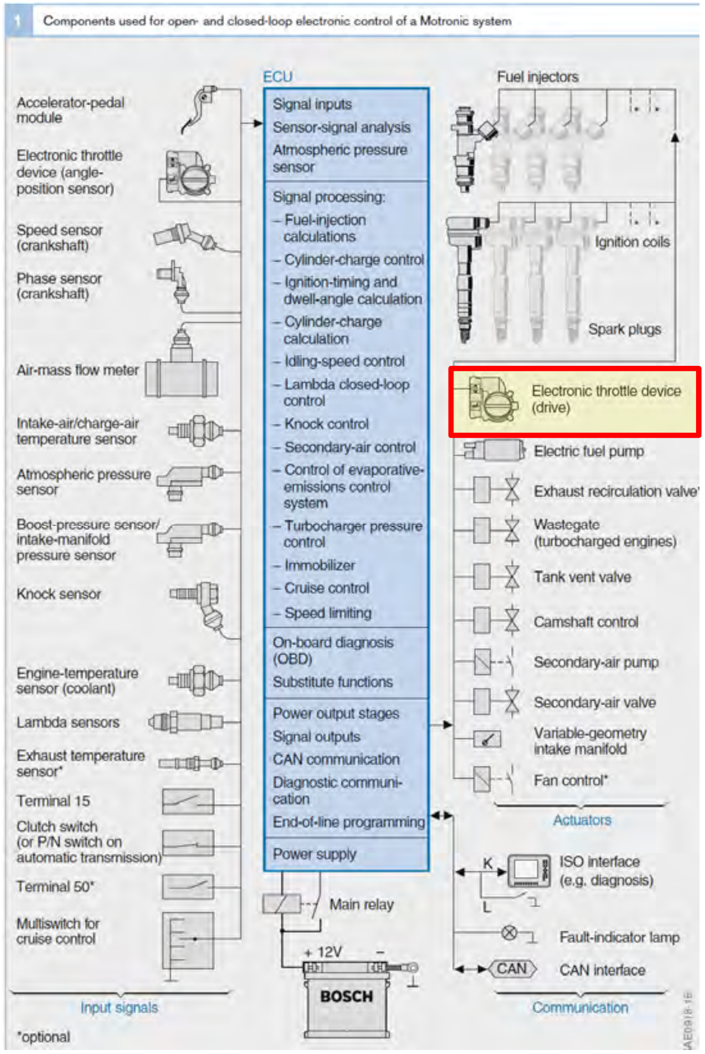
Sensor and setpoint generators

Motronic uses sensors and setpoint generators to collect the operating data required for open- and closed-loop control of the engine (Fig. 1).

Setpoint generators (e.g., switches) record settings made by the driver, such as
- The position of the ignition key in the ignition lock (terminal 15)
- The positions of A/C-control switches
- The cruise-control lever setting

Sensors detect physical and chemical variables, thus providing information about the engine's current operating state. Examples of such sensors are:
- Engine-speed sensor for detecting the crankshaft position and calculating the engine speed
- Phase sensor for detecting the phase angle (engine operating cycle) or the camshaft position
- Engine-temperature sensor and intake-air temperature sensor for calculating temperature-dependent correction variables
- Knock sensor for detecting engine knock
- Air-mass meter, and/or
- Intake-manifold pressure sensor for charge recording
- Lambda oxygen sensor for lambda closed-loop control

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015, at 212.



K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015, at 15.

h. Claim 8

i. Claim 8 recites, "[t]he method of claim 6 wherein said engine operating conditions and parameters include engine speed, engine load, air intake temperature and air intake manifold pressure, atmospheric temperature and atmospheric pressure."

166. Mercedes-Benz vehicles include the Bosch Motronic control systems and are programmed to, upon operation of the Mercedes-Benz vehicle, perform the method of claim 6, wherein said engine operating conditions and parameters include engine speed, engine load, air

intake temperature and air intake manifold pressure, atmospheric temperature and atmospheric pressure.

167. For example, although the Bosch Motronic control system source code that compensates the initial position of the throttle for changes in engine operating conditions and parameters is non-public source code that is in the sole possession, custody and control of the Defendants, Bosch professional automotive information states that Motronic engine management systems monitor the engine operating data for open and closed loop control of the engine. It also states that the throttle is an actuator component of the control system of the engine.

Acquisition of operating data

Sensor and setpoint generators

Motronic uses sensors and setpoint generators to collect the operating data required for open- and closed-loop control of the engine (Fig. 1).

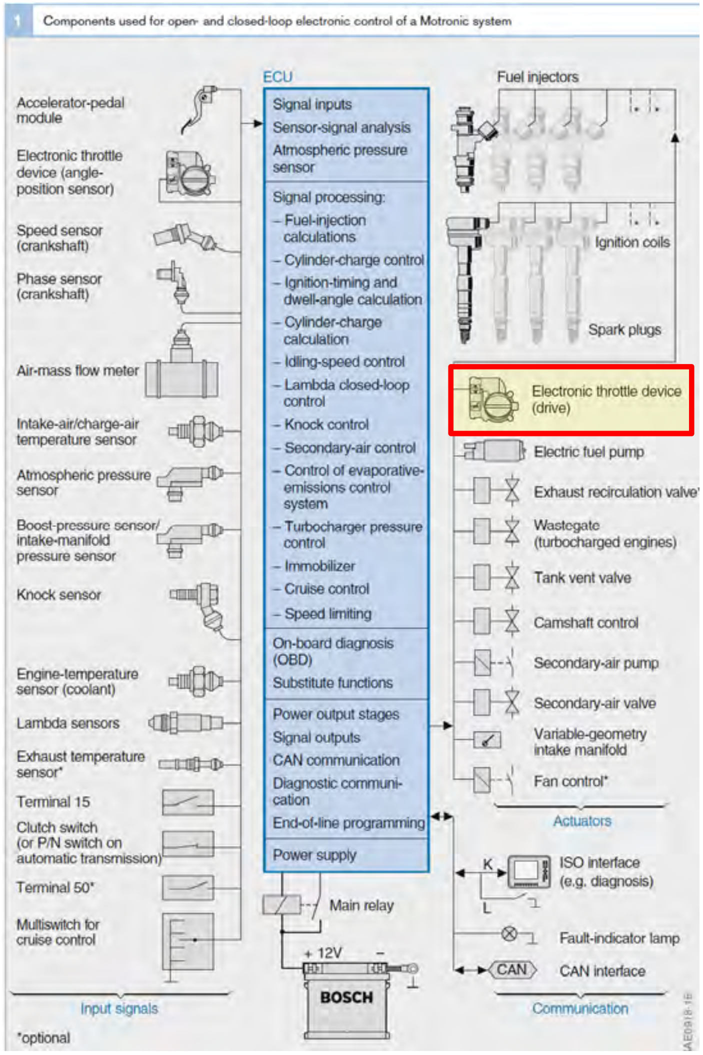
Setpoint generators (e.g., switches) record settings made by the driver, such as

- The position of the ignition key in the ignition lock (terminal 15)
- The positions of A/C-control switches
- The cruise-control lever setting

Sensors detect physical and chemical variables, thus providing information about the engine's current operating state. Examples of such sensors are:

- Engine-speed sensor for detecting the crankshaft position and calculating the engine speed
- Phase sensor for detecting the phase angle (engine operating cycle) or the camshaft position
- Engine-temperature sensor and intake-air temperature sensor for calculating temperature-dependent correction variables
- Knock sensor for detecting engine knock
- Air-mass meter, and/or
- Intake-manifold pressure sensor for charge recording
- Lambda oxygen sensor for lambda closed-loop control

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015, at 212.



K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015, at 213.

- A model is used to calculate the charge drawn in by the cylinder from the engine speed *(n)*, the pressure *(p)* in the intake manifold (i.e., before the intake valve), the temperature in the intake passage and further additional information (e.g., camshaft/valve-lift adjustment, intake-manifold changeover, position of the swirl control valve) (*p/n* system). Sophisticated models may be necessary, depending on the complexity of the engine, particularly with regard to the variabilities of the valve gear.

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015, at 15.

i. Claim 9

i. Claim 9 recites, "[a]n internal combustion engine control system comprising:"

168. Mercedes-Benz vehicles include the Bosch Motronic engine management system, which is an internal combustion engine control system.

169. For example, a Mercedes-Benz vehicle communication software manual from a third party scan tool equipment maker describes Mercedes vehicles as having a Bosch engine management system (ME-Motronic) which uses torque-led control. Automotive "torque based control is possible because the electronic accelerator permits throttle valve control beyond the pedal value inputs."

The ME-MOTRONIC engine management system uses torque-led control, which means it calculates the internal torque produced during combustion. This is the physical force produced by gas pressure during the compression and power strokes. The actual net torque of the engine has to account for friction, gas transfer losses and drive power for ancillary equipment, such as the water pump, alternator and AC compressor. The ME program contains the optimal specifications for charge density, injection duration, and ignition timing for any desired torque, which makes it possible to obtain optimal emissions and fuel consumption for every operational mode. Operational demands are prioritized and coordinated individually to use the appropriate control to achieve the specified torque. Torque based control is possible because the electronic accelerator permits throttle valve control beyond the pedal value inputs.

https://www1.snapon.com/Files/Diagnostics/UserManuals/MercedesBenzVehicleCommunicationSoftwareManual_EAZ0025B41C.pdf.

Electronic control unit "Motronic"

Gasoline Direct Injection - Engine management

Function **Customer benefits**

Function of the electronic control unit "Motronic"

The engine control unit collates all the current data on operating status and requirements for the engine, for instance accelerator pedal position and exhaust-system requirements in relation to the mixture composition. Torque is the key criterion for engine management. According to this criterion, the air-fuel ratio is adjusted in such a way that the torque is provided as economically and cleanly as possible. Bosch Motronic also allows active driving safety systems such as TCS and ESP® to intervene in the engine torque.

http://www.bosch-mobility-solutions.com/en/de/_technik/component/PT_PC_BDI_Engine-Management-NEU_PT_PC_Direct-Gasoline-Injection_02_10178.html?compId=8768.

6 Components used for open- and closed-loop electronic control of an DI-Motronic system (system diagram)

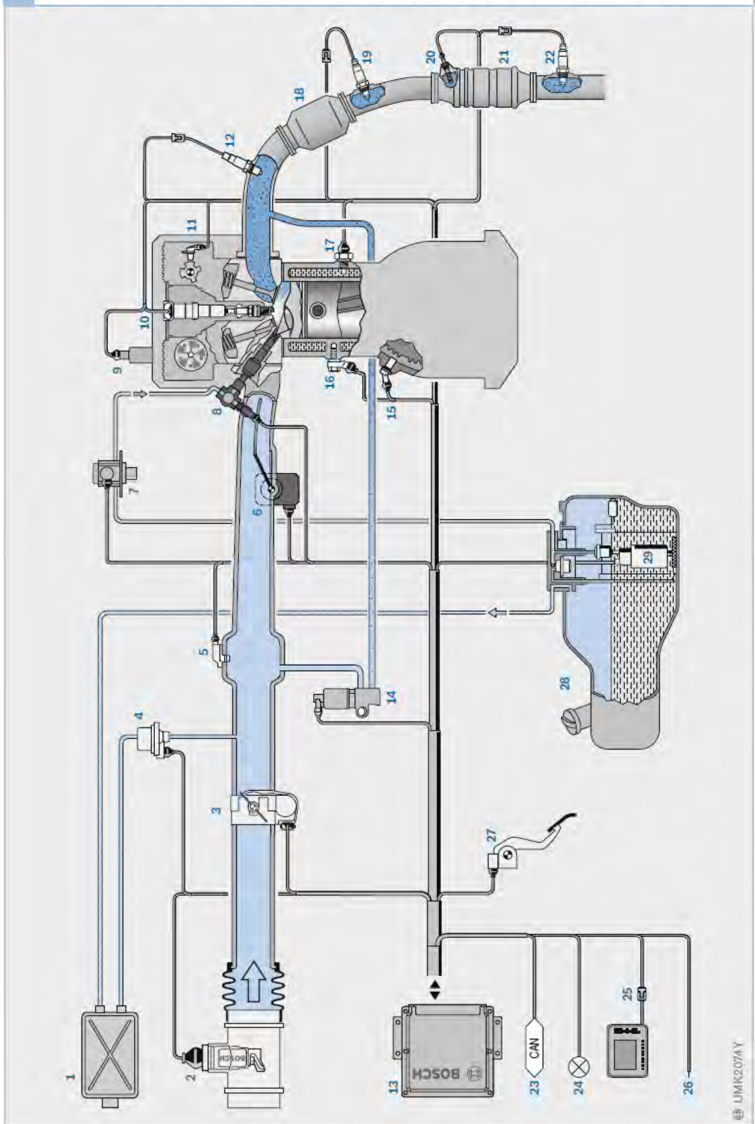
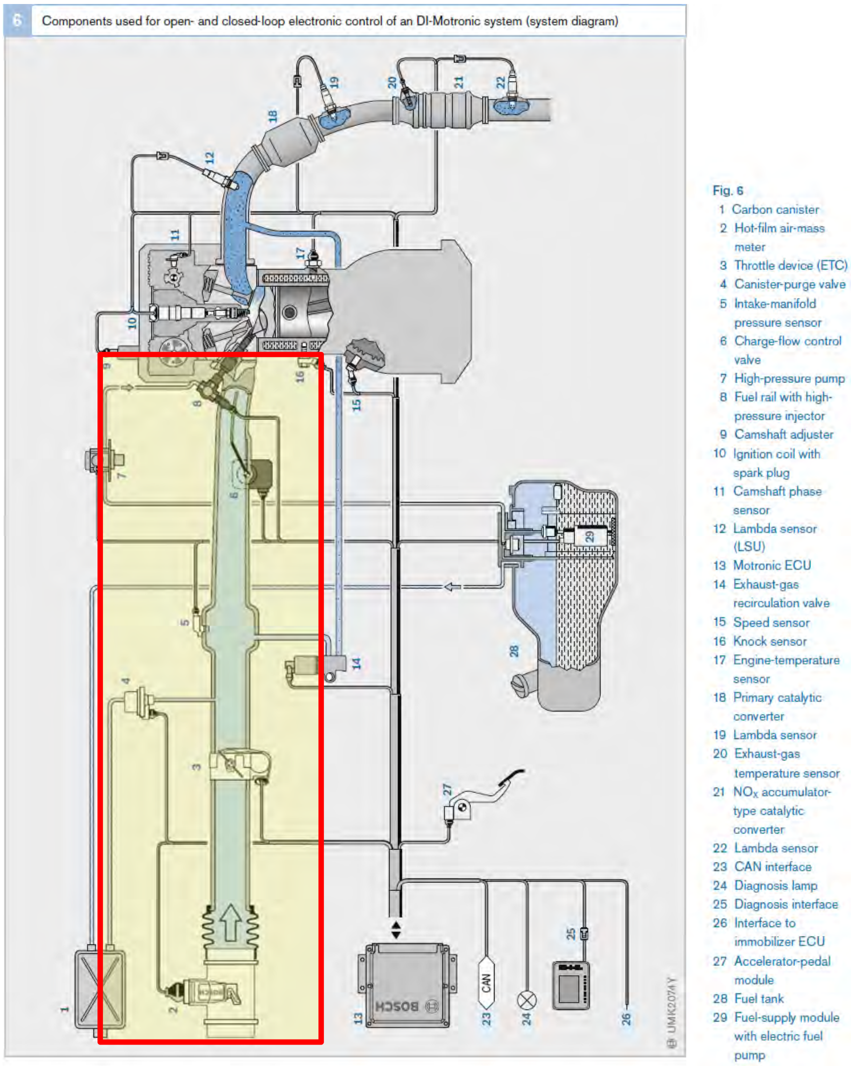


Fig. 6
1 Carbon canister
2 Hot-film air-mass meter
3 Throttle device (ETC)
4 Canister-purge valve
5 Intake-manifold pressure sensor
6 Charge-flow control valve
7 High-pressure pump
8 Fuel rail with high-pressure injector
9 Camshaft adjuster
10 Ignition coil with spark plug
11 Camshaft phase sensor
12 Lambda sensor (LSU)
13 Motronic ECU
14 Exhaust-gas recirculation valve
15 Speed sensor
16 Knock sensor
17 Engine-temperature sensor
18 Primary catalytic converter
19 Lambda sensor
20 Exhaust-gas temperature sensor
21 NO_x accumulator-type catalytic converter
22 Lambda sensor
23 CAN interface
24 Diagnosis lamp
25 Diagnosis interface
26 Interface to immobilizer ECU
27 Accelerator-pedal module
28 Fuel tank
29 Fuel-supply module with electric fuel pump

K. Reif (Ed.), *Gasoline Engine Management,* Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015, at 221.

ii. Claim 9 further recites, "at least one air intake passage through which air flows to the engine;"

170. Mercedes-Benz vehicles include at least one air intake passage through which air flows to the engine.



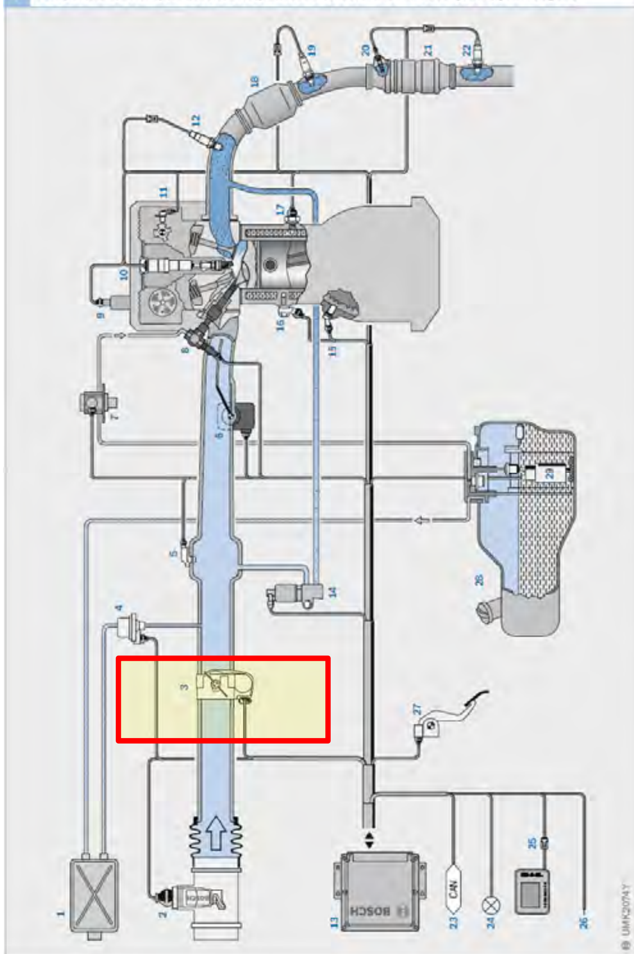
K. Reif (Ed.), *Gasoline Engine Management,* Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015, at 221.

iii. Claim 9 further recites, “first control means located in said at least one air intake passage and being operable to vary the rate of air flow through said at least one air intake passage;”

171. Mercedes-Benz vehicles include a first control means located in said at least one air intake passage and being operable to vary the rate of air flow through said at least one air intake passage.

172. For example, the Mercedes-Benz vehicles include an electronic throttle control (ETC) device in the air intake passage below and labeled as item number three.

6 Components used for open- and closed-loop electronic control of an DI-Motronic system (system diagram)



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12 Lambda sensor (LSU)
13 Motronic ECU
14 Exhaust-gas recirculation valve
15 Speed sensor
16 Knock sensor
17 Engine-temperature sensor
18 Primary catalytic converter
19 Lambda sensor
20 Exhaust-gas temperature sensor
21 NO_x accumulator-type catalytic converter
22 Lambda sensor
23 CAN interface
24 Diagnosis lamp
25 Diagnosis interface
26 Interface to immobilizer ECU
27 Accelerator-pedal module
28 Fuel tank
29 Fuel-supply module with electric fuel pump

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015, at 221.

iv. Claim 9 further recites, “measurement means for determining an actual rate of air flow through said at least one air intake passage; and”

173. Mercedes-Benz vehicles include a measurement means for determining an actual rate of air flow through said at least one air intake passage.

174. For example, Mercedes-Benz vehicles include a mass air flow sensor which is used to determine the actual rate of air flow.

HOT WIRE AIR MASS
HOT FILM MASS AIR FLOW SENSOR
Range: ______________________________ 0 to 500 kg/h

These parameters are an ECU calculation of the mass of the intake air charge in kilograms per hour (kg/h) based on the input of the hot film mass airflow sensor. Normal hot idle values vary depending on engine. In general, readings from 15 to 30 kg/h are normal for a hot engine running at idle with all accessories switched off.

https://www1.snapon.com/Files/Diagnostics/UserManuals/MercedesBenzVehicleCommunicationSoftwareManual_EAZ0025B41C.pdf.


Hot-film mass air-flow sensor HFM

http://www.bosch-mobility-solutions.com/media/en/ubk_europe/db_application/downloads/pdf/antrieb/de_5/gs_datenblatt_heissfilm_luftmassenmesser_de.pdf.

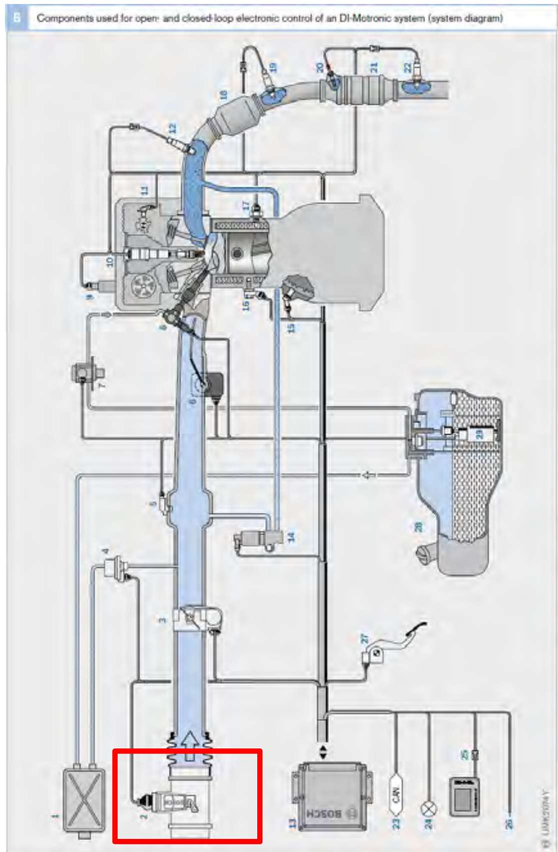

Fig. 6
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16 Knock sensor
17 Engine-temperature sensor
18 Primary catalytic converter
19 Lambda sensor
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21 NO_x accumulator-type catalytic converter
22 Lambda sensor
23 CAN interface
24 Diagnosis lamp
25 Diagnosis interface
26 Interface to immobilizer ECU
27 Accelerator-pedal module
28 Fuel tank
29 Fuel-supply module with electric fuel pump

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015, at 221.

v. Claim 9 further recites, “second control means operable to determine an air and/or fuel requirement of the engine in response to a driver initiated signal;”

175. Mercedes-Benz vehicles include a second control means operable to determine an air and/or fuel requirement of the engine in response to a driver initiated signal.

176. For example, Mercedes-Benz vehicles include a Bosch Motronic ECU that adjusts the air and fuel in response to accelerator pedal position.

Electronic control unit "Motronic"

Gasoline Direct Injection - Engine management

Function   Customer benefits

Function of the electronic control unit "Motronic"

The engine control unit collates all the current data on operating status and requirements for the engine, for instance accelerator pedal position and exhaust-system requirements in relation to the mixture composition. Torque is the key criterion for engine management. According to this criterion, the air-fuel ratio is adjusted in such a way that the torque is provided as economically and cleanly as possible. Bosch Motronic also allows active driving safety systems such as TCS and ESP® to intervene in the engine torque.

http://www.bosch-mobility-solutions.com/en/de/_technik/component/PT_PC_BDI_Engine-Management-NEU_PT_PC_Direct-Gasoline-Injection_02_10178.html?compId=8768.

Motronic comprises all the components which control the gasoline engine (Fig. 1). The torque requested by the driver is adjusted by means of actuators or converters. The main individual components are

- The electrically actuated throttle valve (air system): This controls the air-mass flow to the cylinders and thus the cylinder charge.
- The fuel injectors (fuel system): These meter the correct amount of fuel for the cylinder charge.
- The ignition coils and spark plugs (ignition system): These provide for correctly timed ignition of the air/fuel mixture in the cylinder.

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015, at 212.

vi. Claim 9 further recites, "characterized in that the second control means also determines an initial setting for said first control means upon determination of the air and/or fuel requirement of the engine; said actual rate of air flow is measured by said measurement means and compared with said determined air requirement, the setting of said first control means being controlled by the second control means such that said actual rate of air flow is adjusted to within acceptable operating limits of the determined air requirement."

177. Mercedes-Benz vehicles include a control system characterized in that the second control means also determines an initial setting for said first control means upon determination of the air and/or fuel requirement of the engine; said actual rate of air flow is measured by said measurement means and compared with said determined air requirement, the setting of said first control means being controlled by the second control means such that said actual rate of air flow is adjusted to within acceptable operating limits of the determined air requirement.

178. For example, certain Mercedes vehicles have a Motronic engine management system which uses torque-led control. Automotive "torque based control is possible because the electronic accelerator permits throttle valve control beyond the pedal value inputs."

ENGINE LOAD

Range: ______________________________ 0 to 100%

Used on ME10, ME20, ME27, ME28, and SIM4 systems. This parameter is an ECU-calculated engine load displayed as a percentage. The ECU determines engine load based on RPM, number of cylinders, airflow, and cylinder air charge. Input sensor readings are compared to a theoretical air charge that occurs at standard ECU temperature and pressure (volumetric efficiency). The resulting ratio, called engine load, is expressed as a percentage. With the engine running at idle under a normal load readings should be between 20 to 40%. During normal driving, load should be lower than 80%.

The ME-MOTRONIC engine management system uses torque-led control, which means it calculates the internal torque produced during combustion. This is the physical force produced by gas pressure during the compression and power strokes. The actual net torque of the engine has to account for friction, gas transfer losses and drive power for ancillary equipment, such as the water pump, alternator and AC compressor. The ME program contains the optimal specifications for charge density, injection duration, and ignition timing for any desired torque, which makes it possible to obtain optimal emissions and fuel consumption for every operational mode. Operational demands are prioritized and coordinated individually to use the appropriate control to achieve the specified torque. Torque based control is possible because the electronic accelerator permits throttle valve control beyond the pedal value inputs.

https://www1.snapon.com/Files/Diagnostics/UserManuals/MercedesBenzVehicleCommunicationSoftwareManual_EAZ0025B41C.pdf.

179. Further, for example, the Motronic engine management system calculates the required air mass from the torque to be set.

Cylinder-charge control systems

In the case of a homogeneously operated gasoline engine with a defined air/fuel ratio λ, the output torque and thus the power is determined by the intake-air mass and the injected fuel quantity. The air mass must be proportioned exactly so that λ can be adhered to precisely.

Electronic throttle control (ETC)

For it to burn, fuel needs oxygen, which the engine takes from the intake air. In engines with external mixture formation (manifold injection), as well as in direct-injection engines operating on a homogeneous mixture, the output torque is directly dependent on the intake-air mass. The engine must therefore be throttled for the purpose of setting a defined air charge.

Function and method of operation

The torque requested by the driver is derived from the position of the accelerator pedal. In the case of the ETC system (Electronic Throttle Control), a position sensor in the accelerator-pedal module (Fig. 1, Pos. 1) records this variable. Further torque requests are derived from functional requests, such as, for example, an additional torque when the air-conditioning system is switched on or a torque reduction during a gearshift.

The Motronic ECU (2) – ME-Motronic for systems with manifold injection or DI-Motronic for gasoline direct injection – calculates the required air mass from the torque to be set and generates the triggering signals for the electrically actuated throttle valve (5). In this way, the opening cross-section and thus the air-mass flow inducted by the gasoline engine are set. Using the feedback information from the throttle-valve-angle sensor (3) regarding the current position of the throttle valve, it then becomes possible to adjust the throttle valve precisely to the required setting.

A cruise-control function can also be easily integrated with ETC. The ECU adjusts the torque in such a way that the vehicle speed preselected at the control element for cruise control is maintained. There is no need to press the accelerator pedal.

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015 at 32.

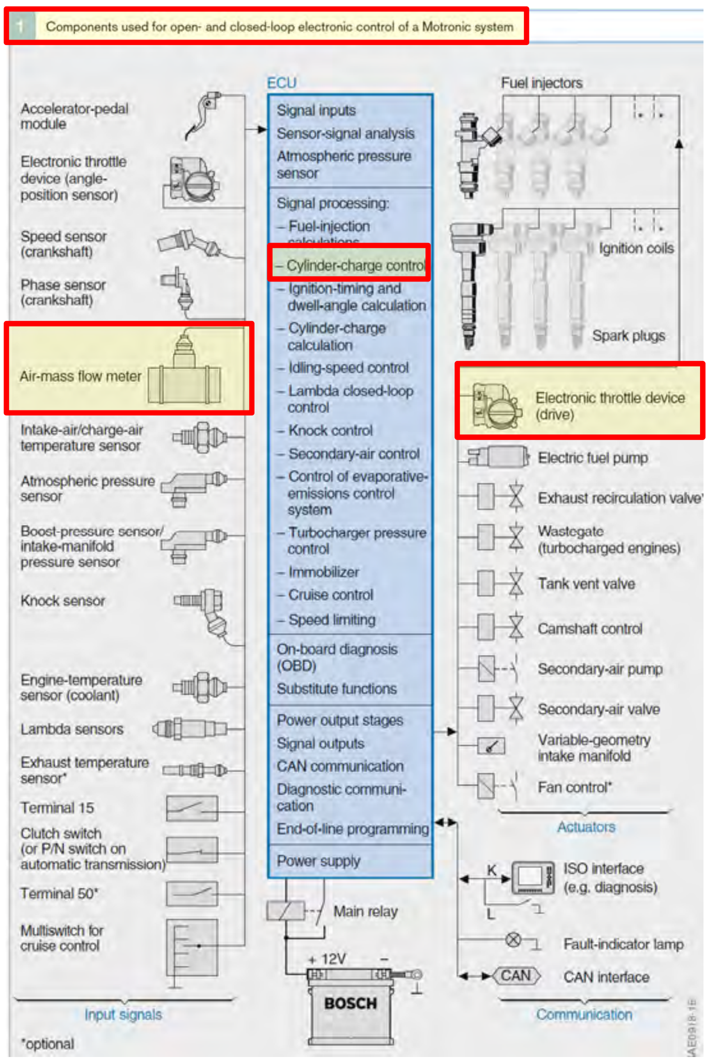
180. Further, for example, Mercedes-Benz vehicles include a mass air flow sensor which is used for feedback to compare the actual rate of air supply with the air demand setpoint.

HOT WIRE AIR MASS
HOT FILM MASS AIR FLOW SENSOR
Range: ______ 0 to 500 kg/h

These parameters are an ECU calculation of the mass of the intake air charge in kilograms per hour (kg/h) based on the input of the hot film mass airflow sensor. Normal hot idle values vary depending on engine. In general, readings from 15 to 30 kg/h are normal for a hot engine running at idle with all accessories switched off.

https://www1.snapon.com/Files/Diagnostics/UserManuals/MercedesBenzVehicleCommunicationSoftwareManual_EAZ0025B41C.pdf.

http://www.bosch-mobility-solutions.com/media/en/ubk_europe/db_application/downloads/pdf/antrieb/de_5/gs_datenblatt_heissfilm_luftmassenmesser_de.pdf.



K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015, at 213.

j. Claim 10

i. Claim 10 recites, "[t]he system of claim 9 including a control loop wherein an actual setting of said first control means is compared with a set point setting and the first control means is adjusted when said actual setting differs from said set point setting by a greater than acceptable margin to bring said actual setting and said set point setting into closer alignment."

181. Mercedes-Benz vehicles include the system of claim 9 including a control loop wherein an actual setting of said first control means is compared with a set point setting and the first control means is adjusted when said actual setting differs from said set point setting by a greater than acceptable margin to bring said actual setting and said set point setting into closer alignment.

182. For example, the Motronic engine management system uses "information from the throttle-valve angle sensor regarding the current position of the throttle valve" to "adjust the throttle valve precisely to the required setting."

Cylinder-charge control systems

In the case of a homogeneously operated gasoline engine with a defined air/fuel ratio λ, the output torque and thus the power is determined by the intake-air mass and the injected fuel quantity. The air mass must be proportioned exactly so that λ can be adhered to precisely.

Electronic throttle control (ETC)

For it to burn, fuel needs oxygen, which the engine takes from the intake air. In engines with external mixture formation (manifold injection), as well as in direct-injection engines operating on a homogeneous mixture, the output torque is directly dependent on the intake-air mass. The engine must therefore be throttled for the purpose of setting a defined air charge.

Function and method of operation
The torque requested by the driver is derived from the position of the accelerator pedal. In the case of the ETC system (Electronic Throttle Control), a position sensor in the accelerator-pedal module (Fig. 1, Pos. 1) records this variable. Further torque requests are derived from functional requests, such as, for example, an additional torque when the air-conditioning system is switched on or a torque reduction during a gearshift.

The Motronic ECU (2) – ME-Motronic for systems with manifold injection or DI-Motronic for gasoline direct injection – calculates the required air mass from the torque to be set and generates the triggering signals for the electrically actuated throttle valve (5). In this way, the opening cross-section and thus the air-mass flow inducted by the gasoline engine are set. Using the feedback information from the throttle-valve-angle sensor (3) regarding the current position of the throttle valve, it then becomes possible to adjust the throttle valve precisely to the required setting.

A cruise-control function can also be easily integrated with ETC. The ECU adjusts the torque in such a way that the vehicle speed preselected at the control element for cruise control is maintained. There is no need to press the accelerator pedal.

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015 at 32.

k. Claim 12

i. Claim 12 recites, "[t]he system of claim 9 wherein said initial setting is an acceptable range of throttle position values."

183. Upon information and belief, Mercedes-Benz vehicles include the system of claim 9 wherein said initial setting is an acceptable range of throttle position values.

184. For example, although the Bosch Motronic control system source code that determines an initial position of the throttle is non-public source code that is in the sole possession, custody and control of the Defendants, acceptable ranges of position values are known to be widely used in automotive control systems.

Cylinder-charge control systems

In the case of a homogeneously operated gasoline engine with a defined air/fuel ratio λ, the output torque and thus the power is determined by the intake-air mass and the injected fuel quantity. The air mass must be proportioned exactly so that λ can be adhered to precisely.

Electronic throttle control (ETC)

For it to burn, fuel needs oxygen, which the engine takes from the intake air. In engines with external mixture formation (manifold injection), as well as in direct-injection engines operating on a homogeneous mixture, the output torque is directly dependent on the intake-air mass. The engine must therefore be throttled for the purpose of setting a defined air charge.

Function and method of operation

The torque requested by the driver is derived from the position of the accelerator pedal. In the case of the ETC system (Electronic Throttle Control), a position sensor in the accelerator-pedal module (Fig. 1, Pos. 1) records this variable. Further torque requests are derived from functional requests, such as, for example, an additional torque when the air-conditioning system is switched on or a torque reduction during a gearshift.

The Motronic ECU (2) – ME-Motronic for systems with manifold injection or DI-Motronic for gasoline direct injection – calculates the required air mass from the torque to be set and generates the triggering signals for the electrically actuated throttle valve (5). In this way, the opening cross-section and thus the air-mass flow inducted by the gasoline engine are set. Using the feedback information from the throttle-valve-angle sensor (3) regarding the current position of the throttle valve, it then becomes possible to adjust the throttle valve precisely to the required setting.

A cruise-control function can also be easily integrated with ETC. The ECU adjusts the torque in such a way that the vehicle speed preselected at the control element for cruise control is maintained. There is no need to press the accelerator pedal.

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015 at 32.

l. Claim 14

i. Claim 14 recites, "[t]he system of claim 9 wherein said driver initiated signal is an accelerator pedal position."

185. Mercedes-Benz vehicles include the system of claim 9 wherein said driver initiated signal is an accelerator pedal position.

186. For example, the Motronic engine management system uses the position of the accelerator pedal to derive the torque requested by the driver.

Cylinder-charge control systems

In the case of a homogeneously operated gasoline engine with a defined air/fuel ratio λ, the output torque and thus the power is determined by the intake-air mass and the injected fuel quantity. The air mass must be proportioned exactly so that λ can be adhered to precisely.

Electronic throttle control (ETC)

For it to burn, fuel needs oxygen, which the engine takes from the intake air. In engines with external mixture formation (manifold injection), as well as in direct-injection engines operating on a homogeneous mixture, the output torque is directly dependent on the intake-air mass. The engine must therefore be throttled for the purpose of setting a defined air charge.

Function and method of operation

The torque requested by the driver is derived from the position of the accelerator pedal. In the case of the ETC system (Electronic Throttle Control), a position sensor in the accelerator-pedal module (Fig. 1, Pos. 1) records this variable. Further torque requests are derived from functional requests, such as, for example, an additional torque when the air-conditioning system is switched on or a torque reduction during a gearshift.

The Motronic ECU (2) – ME-Motronic for systems with manifold injection or DI-Motronic for gasoline direct injection – calculates the required air mass from the torque to be set and generates the triggering signals for the electrically actuated throttle valve (5). In this way, the opening cross-section and thus the air-mass flow inducted by the gasoline engine are set. Using the feedback information from the throttle-valve-angle sensor (3) regarding the current position of the throttle valve, it then becomes possible to adjust the throttle valve precisely to the required setting.

A cruise-control function can also be easily integrated with ETC. The ECU adjusts the torque in such a way that the vehicle speed preselected at the control element for cruise control is maintained. There is no need to press the accelerator pedal.

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015 at 32.

m. Claim 15

i. Claim 15 recites, "[t]he system of claim 9 wherein said first control means is a throttle valve."

187. Mercedes-Benz vehicles include the system of claim 9 wherein said first control means is a throttle valve.

188. For example, the Mercedes-Benz vehicles include an electronic throttle control (ETC) device in the air intake passage below and labeled as item number three.

6 Components used for open- and closed-loop electronic control of an DI-Motronic system (system diagram)

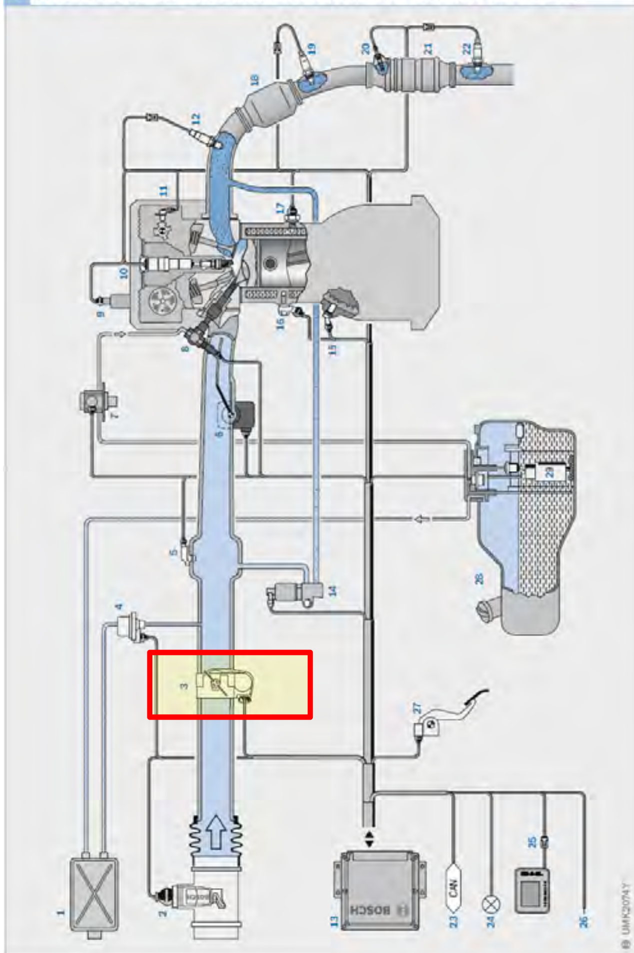


Fig. 6
1 Carbon canister
2 Hot-film air-mass meter
3 Throttle device (ETC)
4 Canister-purge valve
5 Intake-manifold pressure sensor
6 Charge-flow control valve
7 High-pressure pump
8 Fuel rail with high pressure injector
9 Camshaft adjuster
10 Ignition coil with spark plug
11 Camshaft phase sensor
12 Lambda sensor (LSU)
13 Motronic ECU
14 Exhaust-gas recirculation valve
15 Speed sensor
16 Knock sensor
17 Engine-temperature sensor
18 Primary catalytic converter
19 Lambda sensor
20 Exhaust-gas temperature sensor
21 NO_x accumulator-type catalytic converter
22 Lambda sensor
23 CAN interface
24 Diagnosis lamp
25 Diagnosis interface
26 Interface to immobilizer ECU
27 Accelerator-pedal module
28 Fuel tank
29 Fuel-supply module with electric fuel pump

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015, at 221.

n. Claim 23

i. Claim 23 recites, "[a] method of diagnosing faults in an engine air intake system comprising"

189. Mercedes-Benz vehicles include the Bosch Motronic control systems and are programmed to perform, upon operation of the Mercedes-Benz vehicle, a method of diagnosing faults in an engine air intake system.

190. For example, a Mercedes-Benz vehicle communication software manual from a third party scan tool equipment maker describes Mercedes vehicles as having a Bosch engine management system (ME-Motronic) which uses torque-led control. Automotive "torque based

control is possible because the electronic accelerator permits throttle valve control beyond the pedal value inputs."

The ME-MOTRONIC engine management system uses torque-led control, which means it calculates the internal torque produced during combustion. This is the physical force produced by gas pressure during the compression and power strokes. The actual net torque of the engine has to account for friction, gas transfer losses and drive power for ancillary equipment, such as the water pump, alternator and AC compressor. The ME program contains the optimal specifications for charge density, injection duration, and ignition timing for any desired torque, which makes it possible to obtain optimal emissions and fuel consumption for every operational mode. Operational demands are prioritized and coordinated individually to use the appropriate control to achieve the specified torque. Torque based control is possible because the electronic accelerator permits throttle valve control beyond the pedal value inputs.

https://www1.snapon.com/Files/Diagnostics/UserManuals/MercedesBenzVehicleCommunicationSoftwareManual_EAZ0025B41C.pdf.

191. Further, for example, the Motronic engine management system is configured to determine faults within the engine.

Electronic diagnosis
The diagnosis functions integrated in the ECU monitor the Motronic system (ECU, sensors and actuators) for malfunctions and faults, store details of any faults detected in the data memory, and initiate substitute functions where necessary. A diagnosis lamp or a display within the instrument cluster alerts the driver to the faults.

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015, at 216.

- Impacts on the system by the actuator are detected directly or indirectly by a function or plausibility monitor. System actuators, e.g., exhaust-gas recirculation valves, throttle valves, or swirl flaps, are monitored indirectly via control loops (e.g. continuous control variance), and also partly by means of position sensors (e.g. position of the swirl flap).

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015, at 305.

ii. Claim 23 further recites, "at least one air intake passage through which air flows to the engine;"

192. Mercedes-Benz vehicles include at least one air intake passage through which air flows to the engine.

6 Components used for open- and closed-loop electronic control of an DI-Motronic system (system diagram)

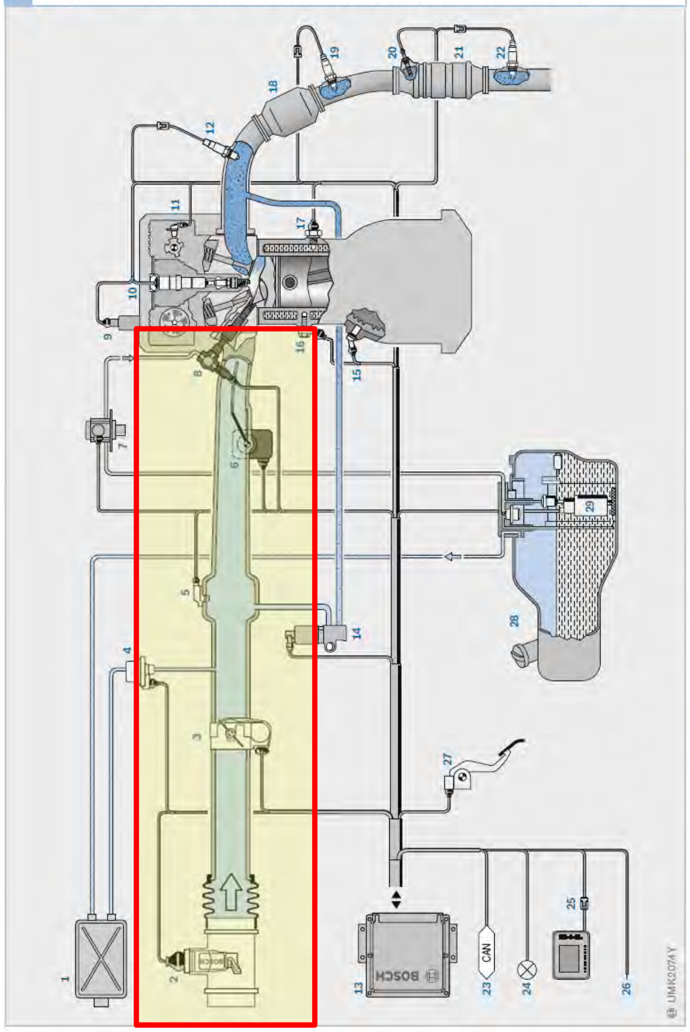


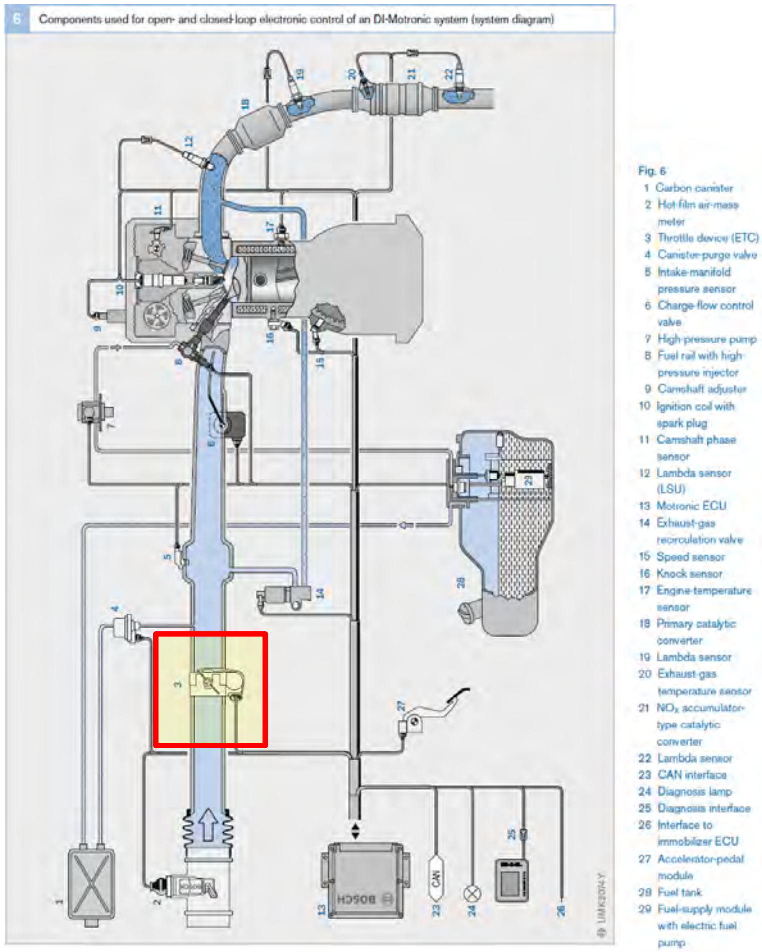
Fig. 6
1 Carbon canister
2 Hot-film air-mass meter
3 Throttle device (ETC)
4 Canister-purge valve
5 Intake-manifold pressure sensor
6 Charge-flow control valve
7 High-pressure pump
8 Fuel rail with high-pressure injector
9 Camshaft adjuster
10 Ignition coil with spark plug
11 Camshaft phase sensor
12 Lambda sensor (LSU)
13 Motronic ECU
14 Exhaust-gas recirculation valve
15 Speed sensor
16 Knock sensor
17 Engine-temperature sensor
18 Primary catalytic converter
19 Lambda sensor
20 Exhaust-gas temperature sensor
21 NO_x accumulator-type catalytic converter
22 Lambda sensor
23 CAN interface
24 Diagnosis lamp
25 Diagnosis interface
26 Interface to immobilizer ECU
27 Accelerator-pedal module
28 Fuel tank
29 Fuel-supply module with electric fuel pump

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015, at 221.

iii. Claim 23 further recites, "first control means located in said at least one air intake passage and being operable to vary the rate of air flow through said at least one air intake passage; and"

193. Mercedes-Benz vehicles include a first control means located in said at least one air intake passage and being operable to vary the rate of air flow through said at least one air intake passage.

194. For example, the Mercedes-Benz vehicles include an electronic throttle control (ETC) device in the air intake passage below and labeled as item number three.



K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015, at 221.

iv. Claim 23 further recites, "second control means operable to determine an air and/or fuel requirement of the engine in response to a driver initiated signal;"

195. Mercedes-Benz vehicles include a second control means operable to determine an air and/or fuel requirement of the engine in response to a driver initiated signal.

196. For example, Mercedes-Benz vehicles include a Bosch Motronic ECU that adjusts the air and fuel in response to accelerator pedal position.

Electronic control unit "Motronic"

Gasoline Direct Injection - Engine management

Function **Customer benefits**

Function of the electronic control unit "Motronic"

The engine control unit collates all the current data on operating status and requirements for the engine, for instance accelerator pedal position and exhaust-system requirements in relation to the mixture composition. Torque is the key criterion for engine management. According to this criterion, the air-fuel ratio is adjusted in such a way that the torque is provided as economically and cleanly as possible. Bosch Motronic also allows active driving safety systems such as TCS and ESP® to intervene in the engine torque.

http://www.bosch-mobility-solutions.com/en/de/_technik/component/PT_PC_BDI_Engine-Management-NEU_PT_PC_Direct-Gasoline-Injection_02_10178.html?compId=8768.

Motronic comprises all the components which control the gasoline engine (Fig. 1). The torque requested by the driver is adjusted by means of actuators or converters. The main individual components are

- The electrically actuated throttle valve (air system): This controls the air-mass flow to the cylinders and thus the cylinder charge.
- The fuel injectors (fuel system): These meter the correct amount of fuel for the cylinder charge.
- The ignition coils and spark plugs (ignition system): These provide for correctly timed ignition of the air/fuel mixture in the cylinder.

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015, at 212.

v. Claim 23 further recites, "wherein said second control means also determines an initial setting for said first control means upon determination of the air and/or fuel requirement of the engine;"

197. Mercedes vehicles perform a method of diagnosing faults in an engine air intake system, wherein said second control means also determines an initial setting for said first control means upon determination of the air and/or fuel requirement of the engine.

198. For example, although the ECU source code that determines an initial position of the throttle means in response to the driver initiated signal is non-public source code that is in the sole possession, custody and control of the Defendants, certain Mercedes vehicles have a Motronic engine management system which uses torque-led control. Automotive "torque based control is possible because the electronic accelerator permits throttle valve control beyond the pedal value inputs."

> The ME-MOTRONIC engine management system uses torque-led control, which means it calculates the internal torque produced during combustion. This is the physical force produced by gas pressure during the compression and power strokes. The actual net torque of the engine has to account for friction, gas transfer losses and drive power for ancillary equipment, such as the water pump, alternator and AC compressor. The ME program contains the optimal specifications for charge density, injection duration, and ignition timing for any desired torque, which makes it possible to obtain optimal emissions and fuel consumption for every operational mode. Operational demands are prioritized and coordinated individually to use the appropriate control to achieve the specified torque. Torque based control is possible because the electronic accelerator permits throttle valve control beyond the pedal value inputs.

https://www1.snapon.com/Files/Diagnostics/UserManuals/MercedesBenzVehicleCommunicationSoftwareManual_EAZ0025B41C.pdf.

199. Further, for example, the Motronic engine management system calculates the required air mass from the torque to be set.

Cylinder-charge control systems

In the case of a homogeneously operated gasoline engine with a defined air/fuel ratio λ, the output torque and thus the power is determined by the intake-air mass and the injected fuel quantity. The air mass must be proportioned exactly so that λ can be adhered to precisely.

Electronic throttle control (ETC)

For it to burn, fuel needs oxygen, which the engine takes from the intake air. In engines with external mixture formation (manifold injection), as well as in direct-injection engines operating on a homogeneous mixture, the output torque is directly dependent on the intake-air mass. The engine must therefore be throttled for the purpose of setting a defined air charge.

Function and method of operation

The torque requested by the driver is derived from the position of the accelerator pedal. In the case of the ETC system (Electronic Throttle Control), a position sensor in the accelerator-pedal module (Fig. 1, Pos. 1) records this variable. Further torque requests are derived from functional requests, such as, for example, an additional torque when the air-conditioning system is switched on or a torque reduction during a gearshift.

The Motronic ECU (2) – ME-Motronic for systems with manifold injection or DI-Motronic for gasoline direct injection – calculates the required air mass from the torque to be set and generates the triggering signals for the electrically actuated throttle valve (5). In this way, the opening cross-section and thus the air-mass flow inducted by the gasoline engine are set. Using the feedback information from the throttle-valve-angle sensor (3) regarding the current position of the throttle valve, it then becomes possible to adjust the throttle valve precisely to the required setting.

A cruise-control function can also be easily integrated with ETC. The ECU adjusts the torque in such a way that the vehicle speed preselected at the control element for cruise control is maintained. There is no need to press the accelerator pedal.

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015 at 32.

vi. Claim 23 further recites, “said actual rate of air flow is measured by said measurement means and compared with said determined air requirement, the setting of said first control means being controlled by the second control means such that said actual rate of air flow is adjusted to within predetermined limits of the determined air requirement characterized in that said initial setting is updated in accordance with engine operating history and stored within a look-up table, said updated setting in said look-up table being compared with said initial setting to determine the occurrence of faults within said engine air intake system.”

200. Certain Mercedes vehicles perform a method of diagnosing faults in an engine air intake system, wherein said actual rate of air flow is measured by said measurement means and compared with said determined air requirement, the setting of said first control means being controlled by the second control means such that said actual rate of air flow is adjusted to within predetermined limits of the determined air requirement characterized in that said initial setting is

updated in accordance with engine operating history and stored within a look-up table, said updated setting in said look-up table being compared with said initial setting to determine the occurrence of faults within said engine air intake system.

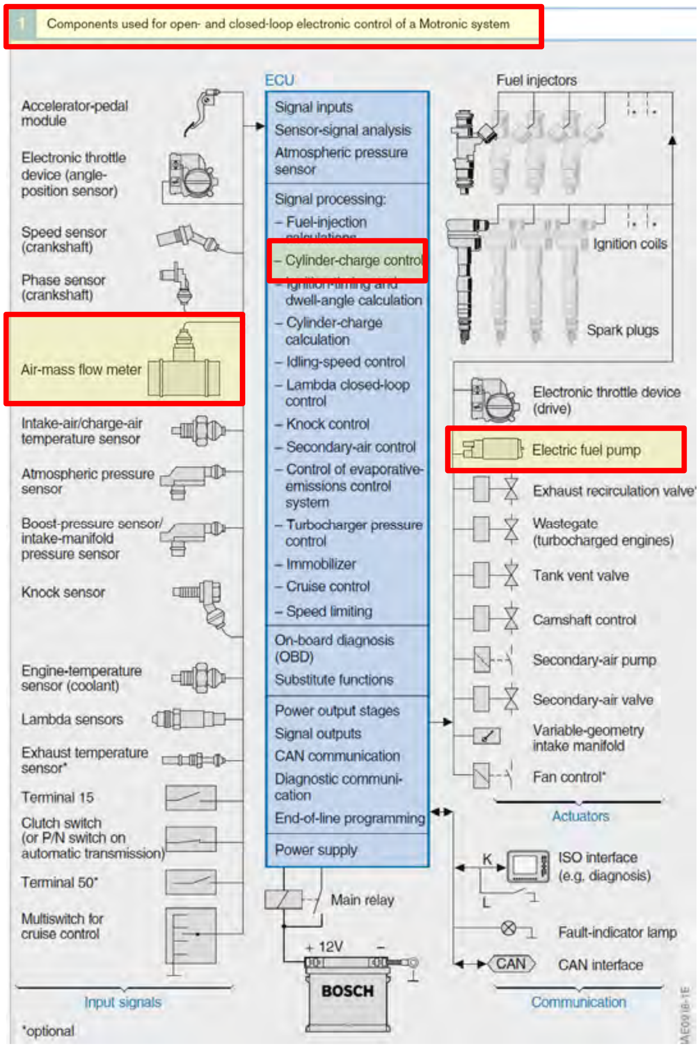
201. For example, although the Bosch Motronic control system source code that determines and adjusts the air flow is non-public source code that is in the sole possession, custody and control of the Defendants, Mercedes-Benz vehicles include a mass air flow sensor which is used for feedback to compare the actual rate of air supply with the air demand setpoint.

HOT WIRE AIR MASS
HOT FILM MASS AIR FLOW SENSOR
Range: ______________________________ 0 to 500 kg/h

These parameters are an ECU calculation of the mass of the intake air charge in kilograms per hour (kg/h) based on the input of the hot film mass airflow sensor. Normal hot idle values vary depending on engine. In general, readings from 15 to 30 kg/h are normal for a hot engine running at idle with all accessories switched off.

https://www1.snapon.com/Files/Diagnostics/UserManuals/MercedesBenzVehicleCommunicationSoftwareManual_EAZ0025B41C.pdf.

http://www.bosch-mobility-solutions.com/media/en/ubk_europe/db_application/downloads/pdf/antrieb/de_5/gs_datenblatt_heissfilm_luftmassenmesser_de.pdf.



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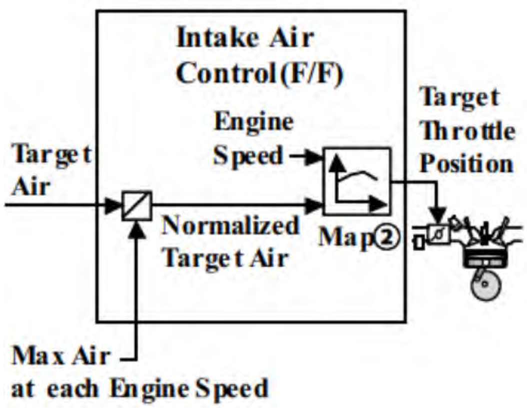
202. Further, look up tables are known to be used in automotive control systems and an example of an intake throttle position look up map is shown below.



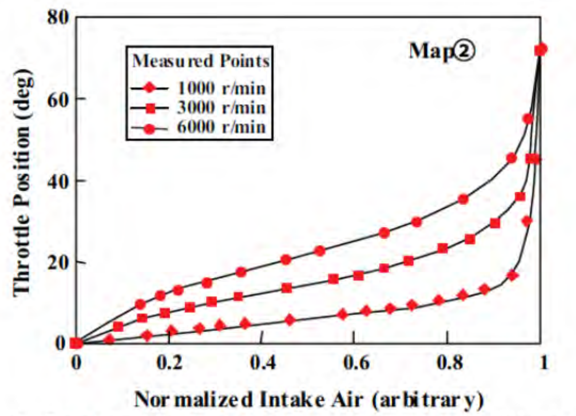


Fig.6 Relationship Between Normalized Intake Air and Throttle Position

Satou, S., Nakagawa, S., Kakuya, H., Minowa, T. et al., "An Accurate Torque-based Engine Control by Learning Correlation between Torque and Throttle Position," SAE Technical Paper 2008-01-1015, 2008.

203. Further, for example, certain types of maps are used Motronic engine management systems that calculate airflow.

Charge Determination and Pressure Model

Charge determination is important for precise torque calculation. After the cam maps were optimized, charge determination was calibrated. The airflow was back-calculated using measured lambda and measured fuel flow and the necessary maps were adjusted. The next step was to develop the intake manifold pressure model on the engine dynamometer. Over 1200 data points were collected and reduced with a custom Bosch tool to determine the pressure model. The pressure model is used to predict transient airflow to ensure that charge is accurately calculated under all conditions including transients.

McNeil, S., Adamovicz, P., and Lieder, F., "Bosch Motronic MED9.6.1 EMS Applied on a 3.6L DOHC 4V V6 Direct Injection Engine," SAE Technical Paper 2008-01-0133, 2008.

204. Further, for example, the Motronic engine management system is configured to determine faults within the engine.

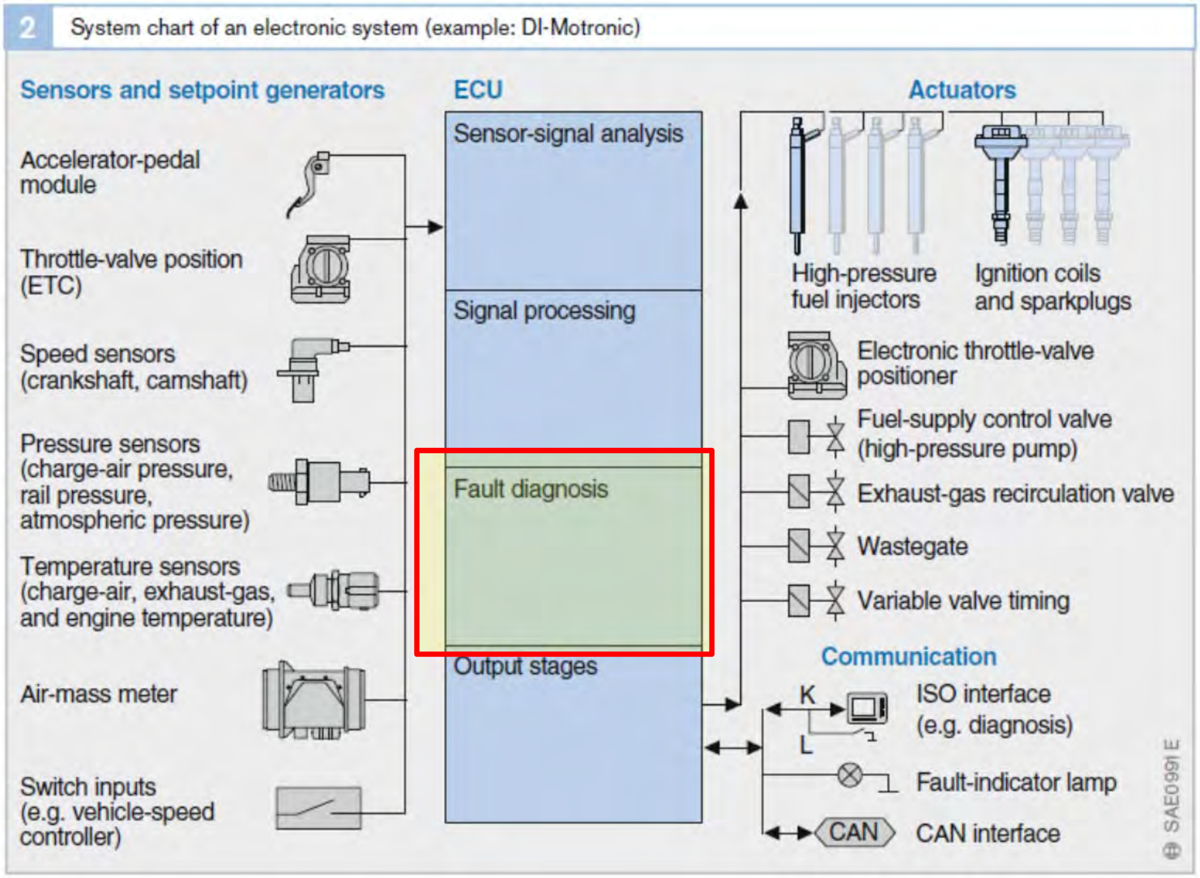
Electronic diagnosis

The diagnosis functions integrated in the ECU monitor the Motronic system (ECU, sensors and actuators) for malfunctions and faults, store details of any faults detected in the data memory, and initiate substitute functions where necessary. A diagnosis lamp or a display within the instrument cluster alerts the driver to the faults.

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015, at 216.

- Impacts on the system by the actuator are detected directly or indirectly by a function or plausibility monitor. System actuators, e.g., exhaust-gas recirculation valves, throttle valves, or swirl flaps, are monitored indirectly via control loops (e.g. continuous control variance), and also partly by means of position sensors (e.g. position of the swirl flap).

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015, at 305.



K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015, at 305.

o. Claim 24

i. Claim 24 recites, "[t]he method of claim 23 wherein, upon diagnosis of a fault within the engine, the air flow to the engine is controlled in accordance with an initial setting for said first control means as determined in response to said driver initiated signal and the setting of said first control means is compared with a tabulated setting applicable to said air and/or fuel requirement of the engine and adjusted when said actual setting of said first control means differs from said tabulated value by a greater than acceptable margin to bring said actual setting and said tabulated setting into closer alignment."

205. Certain Mercedes vehicles perform the method of claim 23 wherein, upon diagnosis of a fault within the engine, the air flow to the engine is controlled in accordance with an initial setting for said first control means as determined in response to said driver initiated signal and the setting of said first control means is compared with a tabulated setting applicable

to said air and/or fuel requirement of the engine and adjusted when said actual setting of said first control means differs from said tabulated value by a greater than acceptable margin to bring said actual setting and said tabulated setting into closer alignment.

206. For example, although the Bosch Motronic control system source code that controls the air flow is non-public source code that is in the sole possession, custody and control of the Defendants, Mercedes-Benz vehicles include a limp home function if a fault is detected.

> Limp-home function
> If a fault is detected, limp-home strategies can be triggered in addition to substitute values (e.g., engine output power or speed limited). These strategies serve to
> - Maintain driving safety
> - Avoid consequential damage, or
> - Minimize exhaust emissions

K. Reif (Ed.), *Gasoline Engine Management*, Bosch Professional Automotive Information, DOI 10.1007/978-3-658-03964-6_4, © Springer Fachmedien Wiesbaden 2015, at 306.

DEMAND FOR JURY TRIAL

Orbital hereby demands a trial by jury in accordance with Rule 38 of the Federal Rules of Civil Procedure.

PRAYER FOR RELIEF

Wherefore, Orbital requests the Court to enter judgment for it and against Mercedes holding that:

A. Each Mercedes defendant has infringed the ’387, ’365, and ’951 patents;

B. Orbital be awarded royalty or lost-profit based damages adequate to compensate them for Mercedes’ infringement of the ’387, ’365, and ’951 patents, such damages to be determined by a jury;

C. Each Mercedes defendant, its officers, agents, employees, and those persons in active concert or participation with it or any of them, and its successors and assigns, be permanently enjoined from continued acts of infringement of the ’387 patent, including but not limited to an injunction against making, using, selling, and/or offering for sale within the United States, and/or importing into the United States, any products that infringe the ’387 patent;

D. Each Bosch defendant has infringed the ’387 patent;

E. Orbital be awarded royalty or lost-profit based damages adequate to compensate them for Bosch’s infringement of the ’387 patent, such damages to be determined by a jury;

F. Each Bosch defendant, its officers, agents, employees, and those persons in active concert or participation with it or any of them, and its successors and assigns, be permanently enjoined from continued acts of infringement of the ’387 patent, including but not limited to an injunction against making, using, selling, and/or offering for sale within the United States, and/or importing into the United States, any products that infringe the ’387 patent; and

G. Orbital be awarded such other and further relief as this Court deems just and proper.

Dated: February 2, 2015

Respectfully submitted,

/s/ *Dana D. McDaniel*

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CERTIFICATE OF SERVICE

I hereby certify that on the 2nd day of February, 2015, I will electronically file the foregoing with the Clerk of Court using the CM/ECF system, which will then send a notification of such filing (NEF) to the following counsel of record who have appeared in this case on behalf of the identified parties:

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